THE AEROPLANE and ASTRONAUTICS

NOVEMBER 6, 1959

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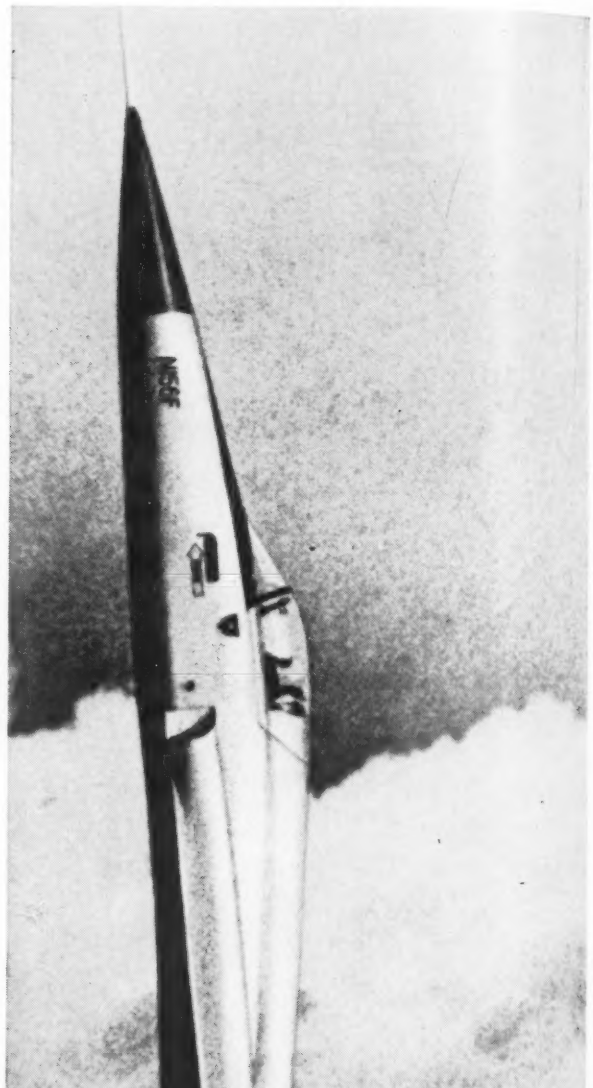
Northrop's N-156F is the first airplane U.S.-designed specifically for defense needs of the other Free World nations. The Freedom Fighter takes advantage of new jet engines, new lightweight materials, new design technology that no other fighter yet reflects. With its multi-purpose mission capability, performance, and ease of operation, the N-156F can virtually double a nation's effective fighting force.

This is because the Freedom Fighter is lighter, smaller, and easier to operate. Light, simple design cuts procurement costs, results in fuel savings and ease of maintenance. The Freedom Fighter cuts by approximately 50% the need for heavy, costly ground support and rare skills.

This highly reliable airplane can take off any time – almost anywhere – scant seconds from the scene of possible air or ground combat. This mobility contributes to quicker reactions. It keeps more aircraft battle-ready along a wider and more dispersed perimeter for maximum striking power – with minimum vulnerability. As a multi-purpose fighter, the N-156F flies air-to-air, air-to-ground, and low-altitude strike and reconnaissance missions.

No weapon system today matches the Freedom Fighter's advantages. It costs less to buy, to fly and to maintain. And because the N-156F is designed for production outside the United States, this new fighter will contribute to the economies of the countries it will defend.

Test pilots use the word "clean" to describe the N-156F's performance. Their reports praise its low- and high-speed flight handling characteristics. They find the new fighter meets and exceeds all the performance indicated and assured by extensive wind tunnel tests. They appreciate its twin-jet safety – its all-weather dependability.



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Priority for Pruning

One way and another British nationalized air transport has cost the taxpayer a lot of money since 1945. Even if we accept as inevitable the losses of the difficult immediate post-war period, B.O.A.C.'s deficits have amounted to rather more than £19 million during the past 10 years.

More than £12 million of this has been accounted for by capital-remuneration (or interest) payments. But the accumulated deficit this year has been increased by £6.5 million, of which £6 million follow a development-cost write-off and provision for loss in the disposal of aircraft bought to fill the gap when the Comet 1s were withdrawn. Thus £25.5 million less £12 million leaves £13.5 million.

Within this last figure, £6 million has been, to use the words in the annual report, a loss "beyond the control of the Corporation." Another uncontrollable loss—that caused by the strike in October, 1958—has been estimated at £1.25 million.

If we subtract these "uncontrollable" losses, amounting to £7.25 million, we are left with a final figure of £6.25 million for a 10-year period which is not quite so devastating—but it is still a loss of some magnitude for an industry which, with so much in its favour, can be shown in practice to be profitable.

The correspondence page in this issue carries a letter on this subject which, as the editorial comment points out, is unfair in fact, but fair in overall judgment. An early problem for Mr. Sandys is to see that the incubus of excess man-power which has plagued B.O.A.C. for so long is dissipated forthwith.

Lightplane Pioneering

Announcement of the sad death of the first man to make a successful solo flight across the North Atlantic from East to West was a forcible reminder of how long ago all that pioneering effort was. Perhaps it is not surprising, therefore, that the tremendous part played in these early flights by aeroplanes of very low horse-power should have been almost entirely overlooked. The extraordinary thing about the pioneering flights of the second decade after the First World War, was the truly remarkable achievements of so-called "light aeroplanes."

Mention needs to be made of the patron of so many British efforts in this field. Few of these flights would ever have taken place if it had not been for the generosity and farsightedness of the late Lord Wakefield, who used to be known as the Patron Saint of British Aviation. In addition let us recall that, like Mollison, the late Bert Hinkler, who had crossed the South Atlantic solo in a Puss Moth two years earlier, relied on a D.H. Gipsy engine.

Manpowered Aircraft and the Provinces

Some 100 people turned up to the first meeting in London of the Manpowered Aircraft Group of the R.Ae.S. last week. When the five members of the panel had finished their talks the discussion was continued at a high level for another hour, and if the President of the R.Ae.S. had not been vigorous with his ruthless "egg-timer," the meeting would certainly have gone on until the small hours.

There can be no doubt about the general interest of R.Ae.S. members and others in the subject of manpowered flight, and we hope there will be chances for interested people in the

Editor - - - - - THURSTAN JAMES
Deputy Editor - - - F. T. MEACOCK

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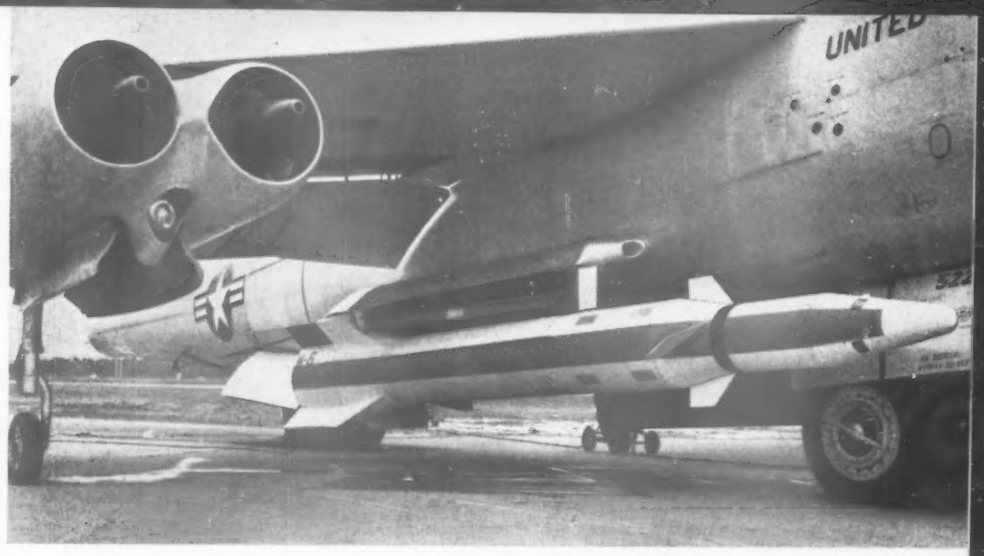

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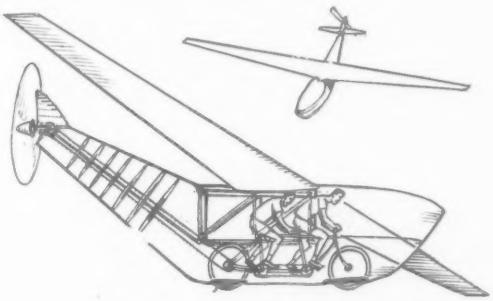

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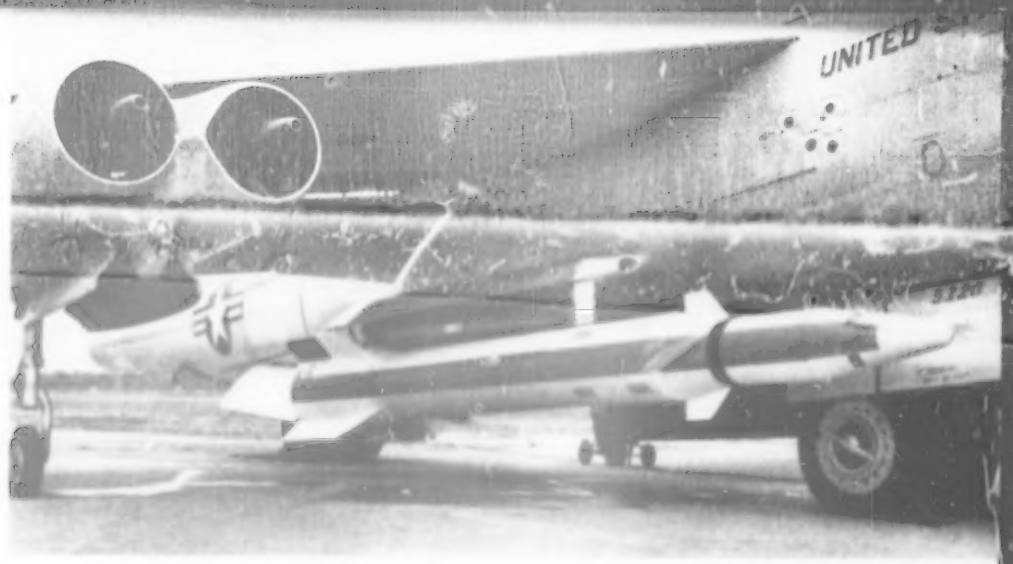

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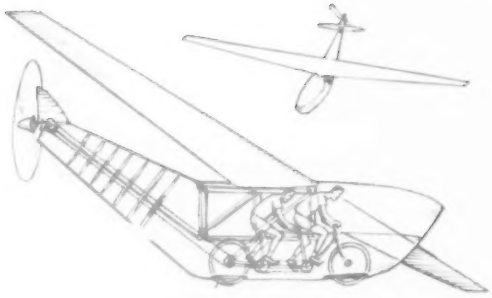

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Recognition for the A.R.B.

LAST week Mr. Walter Tye, O.B.E., chief technical officer of the Air Registration Board, received the Flight Safety Foundation *Aviation Week* Award—the only one to be presented in 1959. This award is for "distinguished service in achieving safer utilization of aircraft," and the choice of the Award Committee is, no doubt, a recognition of the A.R.B.'s work in developing airworthiness requirements for the first turbojet transport to go into airline service and of the forward-looking safety policy of the Board during the past 15 years.

For Research on Noise

ONE of the more pressing of present-day problems is that of noise suppression and reduction; indeed few subjects have received such widespread attention. For this reason alone, the inauguration of an independent research laboratory, especially intended for investigation into fundamental noise problems, is noteworthy.

Last week, we saw for ourselves an excellent example of this sort of facility—a new acoustical research station at Hemel Hempstead, formally opened by Sir Victor Shepheard, director of research at the British Shipbuilding Research Association. It has been built by Acoustical Investigation and Research Organization, Ltd.—commonly known as Airo and a member of the Hall-Thermotank group of companies.

The Airo laboratory, although small, is very well equipped for its task with an anechoic, or echo-free room; a reverberation chamber with reflecting surfaces; and associated source chambers. All these have been developed in close consultation with the N.P.L. and the Building Research Station. And the company claims that the laboratory is the first in this country to have under one roof complete facilities for the acoustic analysis of all types of materials and products "from simple domestic equipment to complex electronic devices."

Although a good deal of the work of the laboratory will be concerned with problems associated with commercial equipment and structures, the company has a close interest in aeronautical noise. We were told, for example, that the investigation of certain missile noise problems figures largely in the present programme—but details were conspicuous by the security silence surrounding them. Other Airo aviation interests are associated with some work for Handley Page in connection with the Dart Herald.

The company was formed about 18 months ago with its headquarters at Cromwell Road, London. It is of particular interest as a "non-trading" organization set up for practical investigation and research into all aspects of noise problems and its consultative services are available to industry on a fee-paying basis.

Principally, the Hemel Hempstead laboratory is equipped to deal with the measurement of acoustic characteristics of machines, materials and electro-acoustic transducers; development projects such as sound insulation in lightweight structures; and fundamental research in acoustic engineering and electro-acoustics.

All the experimental chambers are capacious with a height of between 14 and 17 ft. In addition to the principal test rooms, there is also an underground duct 40 ft. long by 3 ft. square available for experimental work. This contains an anechoic wedge structure which can, if necessary, be blanked off by reflector plates.

Aslib Aeronautical Group

PURSUING their usual policy of providing the best possible service to those to whom they are responsible, the Aslib Aeronautical Group of Librarians mustered about 60 of their members at the Ministry of Aviation on October 29 to learn the workings of the Technical Information and Libraries Section. This is the department that supplies [sic] unpublished report material whether foreign, colonial or home and the visitors heard of the system by which papers come to them automatically for retention or on loan when asked for. It may come as a surprise to some technicians in the Industry to realize that it is thanks to their Librarians that they see anything at all of the work that is being done in other firms or in Government Departments in the United States and in Australia.

The Librarians heard with sympathy of the difficulties of the Ministry. Limitations on the number of copies of a paper available, non-existence of reproduction facilities, delays with liaison in America, are some of the snags in a body that is manifestly doing its utmost with a comparatively small staff to cope with the demands of a hungry industry.

In the circumstances it is surprising that impatient demands are met with such patient forbearance especially when one hears of borrowers to whom one month is not enough as a loan period. One wonders why such borrowers do not make their own photocopies at the outset and return the document forthwith.—"BELTANE."

First Atlantic Soloist Westwards

WITH the death of Jim Mollison in hospital on October 30, we have lost another link with the carefree and exciting pre-war era of record-flying.

Newspaper and radio obituaries, written for the most part by people who cannot appreciate what aviation owes to the long-distance fliers of the 'twenties and 'thirties, have done less than justice to his record-breaking achievements. This is nothing new, for his private life always tended to make more sensational news for certain sections of the Press than did his achievements in the air.

James Allan Mollison was born in Scotland on April 19, 1905, was educated at Glasgow Academy and took a commission in the Royal Air Force at the age of 18 years and three days. The discipline of Service life and flying duties such as "tribal control" punitive operations in Waziristan held no appeal for him; but a course at the C.F.S. in 1927 must have contributed something to his skill as pilot and navigator.

He was transferred to the Reserve in 1928 and, after various adventures in the South of France and Tahiti, became an instructor at the Australian Aero Club in Adelaide. Before long, he travelled a thousand miles across Australia to seek a job with Sir Charles Kingsford Smith who, in his own words, affected him more than any other man in his life. Together they flew as pilots for A.N.A., until one day Mollison asked Cyril Westcott, Wakefield's manager in Australia, if Lord Wakefield would help him to beat the record for the solo flight to England. The answer was "yes" and for the next five years Jim Mollison made flying history, almost entirely on Gipsy engines of 120-130 h.p.

He started badly by hitting a telegraph pole during take-off at Darwin on his first record attempt and writing off his Moth. Lord Wakefield bought him another and this time all went well. His first stage of 1,730 miles from Wyndham to Batavia was possibly the longest day's journey made in a lightplane up to that time and, averaging two hours' sleep a night, he reached England on August 6, 1931, having flown half round the World in a record 8 days 22 hr. 25 min.

Switching to the comparative luxury of an enclosed-cabin Puss Moth, he next set up an England-Cape Town record of 4 days 17 hr. 5 min. on March 24-28, 1932, and on August 18-19 became the first airman to fly the Atlantic solo from east to west. This was perhaps his greatest flight, because it involved flying and navigating the tiny 120 h.p. aircraft for 30¼ hr. from Portmarnock, near Dublin, to Pennfield, New Brunswick, over a route that had already taken the lives of many pilots.

On February 6-9, 1933, he became the first to fly solo over both the North and South Atlantic, by linking Lympne and Port Natal, Brazil, in 3 days 10 hr. 8 min. in the same Puss Moth, which was named the "Heart's Content."

Just before the North Atlantic flight he had married the late Amy Johnson, and they were the first husband and wife to fly the Atlantic together, in a D.H. Dragon, on July 22-24, 1933. Not for the first or last time in their long-distance flights, the journey had an unhappy ending, for the Dragon overturned after touch-down in a swamp outside Bridgeport, Conn., and they finished up in hospital.

In October, 1934, when leading the field in the MacRobertson Air Race to Melbourne in their Comet racer "Black Magic," they had to withdraw with undercarriage trouble at Karachi, after breaking the England-India record.

Two years later Jim Mollison set yet another transatlantic record, flying solo from Harbour Grace, Newfoundland, to Croydon in 13 hr. 17 min. This time he piloted a Bellanca monoplane, and he would have raised the England-Cape record in it two months later had not bad weather prevented his landing at Cape Town.

These feats of courage and endurance earned him the Britannia Trophy in 1933 and the Johnston Memorial Air Navigation Trophy. They do not represent the sum of Jim Mollison's flying, for he was awarded the M.B.E. for his service as a ferry pilot with Air Transport Auxiliary in the Second World War. But they are the exploits by which he should be remembered. He wrote this valediction in his autobiography:—

> "Be kind in your judgment of me . . . I am not wholly indifferent to what people think of me. Remember I am kind to animals, I do not rob blind men, I have an immediate capacity for falling in love, I weep at music that appeals to me and I am indifferent to death."
>
> J.W.R.T.

WRONGOTAI WRENDEZVOUS-

NEW ZEALAND'S TRADITIONAL SUNDAY SOMNOLENCE WAS SCATTERED TO THE WINDS ON OCTOBER 25 WHEN THAT COUNTRY'S BIGGEST AIR DISPLAY OPENED WELLINGTON AIRPORT, BUILT ON THE OLD RONGOTAI AIRFIELD SITE.

THE NEW AIRPORT, "HACKED FROM ROCK, WON FROM THE SEA", HAS A 5,350 FT. RUNWAY AND DEFIES INTERNATIONAL PRECEDENT BY BEING ONLY 4½ MILES FROM THE CITY CENTRE.

THE PROCEEDINGS WERE OPENED BY AN RNZAF SUNDERLAND STRIKING SPARKS FROM THE RUNWAY

BUT THE TOP-DRESSING BOYS, WITH A QUICK SHAMPOO, RESTORED THE PRISTINE SHEEN WHICH NOT EVEN...

THINKS: "BE THANKFUL FOR THE OLYMPUS AT A TIME LIKE THIS"

THE DISPLAY MAKERS

ROGER JAMIESON
i/c Flying, also Asst. Gen'l. Man.-DHNZ.

DOUG PATTERSON
Chairman Display C'ttee also P.R.O.-NZNAC

G/C STAN QUILL
i/c Service Flying—also G/C Ops. Dept. of Air

...THE HERCULES' FANTASTIC GO-UP NOR

THE VULCAN'S HEAVY COME-DOWN COULD REMOVE.

THE 100,000 SPECTATORS WERE DISAPPOINTED THAT THE HERALD AND THE FRIENDSHIP DIDN'T SETTLE, THERE AND THEN, THEIR DISPUTE FOR THE N.A.C. ORDER

"THERE, BUT FOR THE GRACE OF AUSTRALIA, GO WE..."

THEY WERE SORRY, TOO, THAT THE COMET 4 WASN'T PRESENT TO DEMONSTRATE WHAT TEAL WERE MISSING

"FARNBOROUGH WAS NEVER LIKE THIS!"

AMONG THOSE PRESENT

Air Marshal SIR DENIS BARNETT, *C.-in-C. Transport Cd.*

A.V.M. J.G. DAVIS, *A.O.C. 1 Gp. Bomber Cd.*

Col. JOHN R. MURPHY *Cdr. U.S.A.F. Contingent*

Gp. Capt. "JO" BARNARD *—he rules the Britannias*

Wg. Cdr. DOUGLAS BAGNALL *O.C. Flying Wing Scampton*

Wg. Cdr. JIM GRANEY *C.O. No. 1 Sqn. of Canberras, R.A.A.F.*

Flg. Off. TOM ENRIGHT

Flg. Off. RUSSELL BRANKS

Flt. Lt. COLIN RUDD
No. 14 "KIWI" SQUADRON, R.N.Z.A.F., PUT ON A SPLENDID "JETOBATIC" DISPLAY IN VAMPIRES. SOON TO BE REPLACED BY CANBERRAS.

Flg. Off. PETER RHODES

IF YOU WANT TO WRITE TO THE WELLINGTON AIRPORT A.T.C.O., THE ADDRESS IS No. 29, TIRANGI RD., RONGOTAI (THE FOURTH ROAD ON THE RIGHT AS YOU LEAVE THE AIRPORT)

(Down Under)

By courtesy of Handley Page Ltd., Wren is in New Zealand and Australia accompanying the Dart Herald on its demonstration flights. This is his first report.

Air Transport

Afterthoughts

EVEN when B.O.A.C.'s house is finally in really good order the Corporation will have set itself a considerable task in profitably filling the ton-mile capacity which will be available before 1965.

It has been said that, to be profitable, an airline's fleet must earn at least its own capital value every year. B.O.A.C.'s fleet and spares are valued in the current report at £68.4 million and the total revenue for 1958-59 was £58.4 million. The value of the fleet in 1963 is expected to be of the order of £130 million, so, if the fleet-earning fact is even approximately true, revenue must be increased by 122% in four years, or by 24% per annum—which will take some doing.

A Bill to increase the borrowing powers of the two Corporations was published on October 30. This enables B.O.A.C. to borrow up to £180 million (or £20 million more) and B.E.A. to borrow up to £95 million (or £35 million more).

Comet 4Cs for Mexico

THE first order for the Comet 4C—which might be described as a long-range version of the big-capacity 4B—has been placed by Cia Mexicana de Aviacion, an affiliate of Pan American World Airways. Three have been ordered at a cost, with spares and ramp equipment, of $14 million (about £5 million). The first two will be delivered in December and the third in the summer of 1960.

The Comet 4C is, in effect, a Mk. 4 with a Mk. 4B fuselage and the early delivery of the first two aircraft for Mexicana has been made possible by the facts that the order has been expected for several months, that de Havilland have been anticipating this and other orders in their planning and are, in any case, well ahead of production schedule, and that deliveries of 4Bs to B.E.A. are in two groups to suit increasing traffic requirements. Wings and fuselages of the two variants have therefore been available for the first two aircraft for Mexicana and the third aircraft will come along in the more normal course of production progress.

The 4C can carry a 24,600-lb. payload over a no-reserve range of 3,140 naut. miles and has the benefit of the recent increase in gross weight to 162,000 lb. Mexicana will use the Comet on their international services to Los Angeles, Chicago and Havana, and its good field performance will be particularly suitable for operations out of Mexico City's airport which, with its 7,350-ft. altitude and high temperatures, is a difficult one for heavily loaded turbojet transports. The Comet, with its relatively small capacity, is also well adapted to the traffic potentials on these routes.

Mexicana's aircraft will be laid out as 86-seaters, carrying 22 first-class and 64 tourist-class passengers. There are now 39 Comet 4s, 4Bs and 4Cs on order or delivered.

In Support of Blackbushe

FOURTEEN companies were represented at a meeting held on October 15 to inaugurate a Blackbushe Airport Tenants' Association. The principal purpose of the association is to represent companies likely to be affected by the threatened closure of the airport, and to do all in its power to obtain a reversal of the decision already taken "in principle" by the former M.T.C.A., to close it before the end of 1960.

The meeting elected a committee as follows: Mr. C. G. Claydon (chairman), Mr. D. Goldstein (vice-chairman), Mr. E. Wetherer (secretary), Mr. Moores and Captains Donati, Bright and Wigley. This committee has approached the Minister of Aviation requesting a meeting to discuss the position, and is compiling information to refute the reasons given by the Ministry for wishing to close the airport.

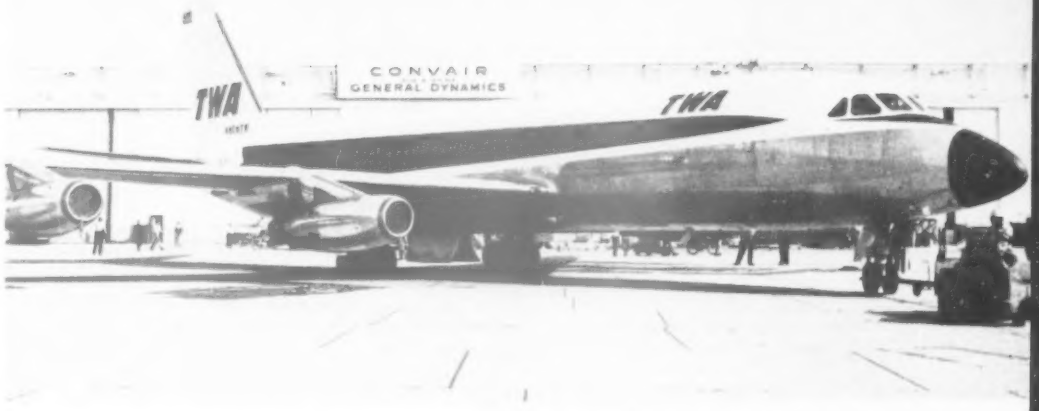
Short-haul Luxury

ALTHOUGH no operator would, unless forced by competition, normally put a turbojet aircraft on a run as short as that between London and Paris, there is, in fact, such a service available and the experience of riding on it is a really remarkable one.

Air France at present schedules three return London-Paris services a week with the S.E. Caravelle. There is, we believe, an understanding between B.E.A. and Air France that turbojets shall not be used normally for this operation; these six movements a week are quite incidental and are, in effect, positioning flights for the non-stop London-Nice services. But the passenger who is lucky enough to have booked a seat on one of these comparatively rare services will have a happy surprise.

The experience of turbojet flying on the London-Paris run is all too ridiculously short: one has hardly settled down to the business of actually enjoying the ride—which, in its extraordinary quietness and smoothness, is more like a flight in a glider than a powered aeroplane—when the warning comes over the loudspeakers that the air-brakes are going to be applied and the Caravelle is sliding rather "buffetingly" down to a straight-

THE COMET 4C.—As noted above, three of the 4C version of the Comet have been ordered by Cia Mexicana de Aviacion. Here is the first for this operator taking off on its maiden flight at Hatfield.



FIRST FOR T.W.A.—Previously seen only in Convair and General Dynamics markings, the 880 has now reached airline-styling status. This is the first of 30 for T.W.A. which will put the 880 into service next spring on first-class-only services. F.A.A. certification flights begin this month.

in approach to Orly. A London-Paris flight on the Sunday before last took about 37 minutes from brakes-off to touchdown. It was a clear evening and night, and even at our modest cruising altitude of 25,000 ft. the countryside and Channel coasts slipped by with noticeable rapidity at a T.A.S. of 380 knots.

Even to one who has flown in the Caravelle before—and in other turbojet transports—the quietness, even on the take-off and climb, comes as a complete surprise. Air France's Caravelles are laid out with a mixed-class arrangement—with, as in all turbojet interiors, the first-class compartment forward in the ultra-peaceful area.

Returning from Paris next day on the "Epicurean" service, one wondered yet again at the popularity of this relic of earlier days when air travel was a luxury and when legs could be stretched and there was more time to enjoy meals provided on this and the "Silver Wing" service. The passengers are wined and dined (or lunched) in the grandest way, but at break-neck speed and while crammed into five-breast seating. Yet the modern "Epicurean" service, with all its minor discomforts—and partly because it is conveniently timed—still enjoys very high day-by-day load factors and the cabin crews remain cheerful, helpful and polite through the mad rush involved in serving 50 passengers, clearing the trays away, *and* selling cigarettes and half-bottles of Cognac, in about 50 minutes flat.—H.A.L.

B.O.A.C. and its Associates

FOR the first time B.O.A.C.'s report for 1958-59 (summarized in last week's issue) included some detailed information about the various companies in which B.O.A.C. Associated Companies, Ltd., has an interest. For the record, this information is summarized below.

Aden Airways, Ltd.
This is a wholly owned subsidiary. Revenue: £912,544. Operating expenditure: £887,404. Financial and other provisions: Credit £4,611. Profit of £29,751 compared with loss in 1957-58 of £103,011.

Arab Airways (Jerusalem), Ltd.
Revenue: £200,243. Expenditure: £227,468. Net loss of £27,225 compared with net loss in 1957-58 of £46,366. This company, which was based on Jordan, ceased operations on October 31, 1958, and is being wound up.

Bahamas Airways, Ltd.
Revenue: £268,012. Operating expenditure: £374,059. Interest and other provisions: £6,131. Net loss of £112,178 compared with net loss in 1957-58 of £90,465.
B.O.A.C. Associated Companies, Ltd., has disposed of 80% of its shareholding to Skyways (Bahamas), Ltd., and has had only 20% interest from April 1, 1959. Mr. Harold Christie retired as chairman on March 31, 1959.

Borneo Airways, Ltd
Revenue: £64,142. Operating expenditure: £81,809. Net loss of £17,667 compared with net loss in 1957-58 of £11,487. With the greater capacity of the Twin Pioneer, introduced in the place of the Rapides previously operated by Malayan Airways, Ltd., a break-even result could not be expected for a year or two. Nevertheless, the loss for the year, of which B.O.A.C. Associated Companies, Ltd.'s proportion is £17,667, is less than was expected.

British International Air Lines, Ltd.
This is a wholly owned subsidiary. Revenue: £246,124. Operating expenditure: £239,010. Financial and other provisions: Credit £3,787. Profit of £8,901 compared with a profit in 1957-58 of £12,153.

British West Indian Airways, Ltd.
This is a wholly owned subsidiary. Revenue: £3,348,856. Operating expenditure: £3,911,834. Interest and other provisions: £29,466. Net loss of £592,444 compared with net loss in 1957-58 of £260,588.
At the instigation of the Corporation, a review of this company's organization and operations was carried out during the year by Air Cdre. G. J. Powell. As a result of his findings, changes in the organization and consequential economies should produce improved results in the current year 1959-60. Air Cdre. Powell has now joined the Board as a full-time director nominated to represent B.O.A.C. Associated Companies. During the year Mr. Hugh Wooding became chairman in succession to Sir Errol dos Santos, who was appointed president.

Gulf Aviation Co., Ltd.
Revenue: £255,103. Operating expenditure: £244,686. Financial and other provisions: Credit £2,661. Profit of £13,078 compared with profit in 1957-58 of £15,072.

Hong Kong Airways, Ltd.
Revenue: £909,615. Operating expenditure: £930,178. Interest and other provisions: £83,987. Net loss of £104,550 compared with net loss for 1957-58 of £167,004.
Early in December, 1958, B.O.A.C. Associated Companies acquired 100% of the share capital; later in the month, the Corporation agreed with Cathay Pacific Airways that from February 1, 1959, the management of Hong Kong Airways would be vested in Cathay Pacific Airways and that by July 1, 1959, Cathay Pacific Airways would acquire the whole capital of Hong Kong Airways. B.O.A.C. Associated Companies now has a 15% interest in Cathay Pacific Airways.

Malayan Airways, Ltd.
Revenue £539,527. Operating expenditure: £521,398. Financial and other provisions: £18,129. Profit—loss nil compared with net profit in 1957-58 of £47,352.
Since April 1, 1958, B.O.A.C. Associated Companies and Qantas Empire Airways have had equal shareholdings in this company and between them hold the majority interest. The Malayan, Singapore and Borneo Governments are the main shareholders of the balance.

Middle East Airlines
Revenue: £3,202,939. Operating Expenditure: £4,078,034. Interest and other provisions: £852,106. Net loss of £1,727,201 compared with net profit in 1957-58 of £92,100.
With effect from April 1, 1959, Middle East Airlines became a direct responsibility of B.O.A.C. Associated Companies. Its operations for several weeks were seriously disrupted by the revolution in the Lebanon, and the consequences of this occurrence, together with other political disturbances in the Middle East reduced the Company's traffic to small proportions. In addition, the Company operates at the disadvantage of being financed, except for 10% of its capital, by loans carrying a high rate of interest.
The results for the first six months of the current year 1959 are encouraging, and measures to effect a drastic reduction of losses are in progress.

Mideast Aircraft Service Co.
Revenue: £575,409. Operating expenditure: £625,770. Interest and other provisions: £109,103. Net loss of £159,464 compared with net loss in 1957-58 of £48,425.

Kuwait Airways
Revenue: £475,613. Operating expenditure: £694,682. Other financial provisions: £18,750. Net loss of £237,819 for the 10 months to March 31, 1959.

Of these 12 companies two no longer exist. Arab Airways has been merged with Air Jordan, in which B.O.A.C. has no interest, and Hong Kong Airways, as explained in the note, has been merged with Cathay Pacific Airways. In addition, the Corporation had, at the end of the 1958-59 financial year, investments in Ghana Airways (£160,681), T.H.Y. Turkish Airlines (£500,000) and WAAC (Nigeria) (£200). To the last two advances had been made by B.O.A.C. Associated Companies of £1,432,383 and £230,000 respectively. Altogether the Corporation's investments in, and advances to, subsidiary and associated companies amounted to £12,624,184.

B.O.A.C.'s TRAFFIC RESULTS SUMMARIZED

	1958/59	1957/58
Capacity ton-miles offered	376,733,000	329,735,000
Revenue load ton-miles flown:		
Passenger	144,688,000	131,872,000
Mail	20,802,000	20,201,000
Freight	36,010,000	37,572,000
Total	201,500,000	189,645,000
Revenue load factor	57.0%	60.5%
Available seat-miles flown (million)	2,492	2,127
Passenger load factor	60.4%	63.3%
Traffic revenue per load ton-mile, d.	61.8	61.8
Traffic revenue per capacity ton-mile, d.	36.9	38.6
Operating costs per capacity ton-mile, d.	36.2	38.7
Passenger revenue per passenger mile, d.	6.5	6.4
Break-even load factor	60%	63%
Unduplicated route mileage	72,416	65,918

Air Transport . . . .

Towards Automatic A.T.C.

ONE of the papers at the recent Anglo-American Aeronautical Conference provides some new and detailed information about the U.S. Federal Aviation Agency's plans for progress towards automation in air traffic control. In particular the paper* described the operation of the A.T.C. Data Processing Central which is expected to go into operational service in 1963 as part of the F.A.A.'s Phase 2 five-year plan.

Phase 1 of the programme consists of a continued effort to improve existing facilities while using present equipment and facilities (including interim off-the-shelf computers which will do routine calculations of E.T.A.s and print flight-progress strips); Phase 2 (begun in 1957) involves the systematic application of existing techniques to provide a co-ordinated semi-automatic system; and Phase 3 is the continuing programme of research and development for better control after the mid-1970s.

In February, 1958, the General Precision Laboratory was selected to develop a semi-automatic system of data processing and display known as the A.T.C. Data Processing Central. This is the basis of the F.A.A.'s Phase 2 five-year plan. The D.P.C. is evolutionary in concept, designed to be inherently flexible and capable of future growth. It is intended to increase the capacity of today's system through the automation of most routine, repetitive, non-decision-making chores. The words "non-decision-making" should be stressed, because the final decision will always rest with the controller.

The hub of the D.P.C. is the data processor. This is a transistorized digital computer which contains a high-speed memory (4,000 words in cores) and a file control unit. Up to 16 file drums, each capable of storing 2,000 blocks of data, may be used with the data processor. Each block contains eight words, or 64 characters. Both active and back-up data are continuously checked for parity errors. The data processor can, in an hour, up-date 6,000 flight progress strips, make 1,770 conflict checks, print out 1,600 flight progress strips, process 440 flight plans and accept 2,600 keyboard entries.

In the existing A.T.C. system, flight plans are transmitted by teletypewriter circuits, telephone lines and by direct intercommunications lines. The computers being installed in the Air Route Traffic Control Centres will be able to accept flight plans directly from the users and from adjacent centres. To permit this, incoming flight plans will be standardized for acceptance by the machines. A flight-data entry device, called FLIDEN, is being developed to ensure that flight plans contain no format errors.

The controller's console for the experimental automatic ground-air-ground communication system (AGACS) under development for the F.A.A. by the Radio Corporation of America. Using the data-entry controls (below the operator's hand) messages are composed and sent in pulse-code to aircraft using the system. Incoming and outgoing messages appear in the windows above the flight progress board. Messages are similarly displayed in a miniature panel in the airborne part of the equipment.

On receiving a new flight plan, the computer will store it in memory. When a flight plan's status is changed from "pending" to "active" the computer causes a flight-strip punch and printer to prepare fix-posting (or flight-progress) strips for the controllers. The strip is taken by the controller and inserted into a strip holder which is, in turn, placed in its appropriate location in a tabular bay.

When a flight plan for an aircraft entering from another area becomes "active" the computer automatically conducts a conflict search—it compares the new plan with all the others already in the machine to determine any potential conflict of arrival times and altitudes at the various points along the proposed route. It automatically calculates the estimated times of arrival of the aircraft over fix points. In calculating times of arrival the computer considers the distance between points, the flight-plan true airspeed and the effect of the wind.

As the pilot reports from the various navigational check points, the controller, using a keyboard-entry device, "advises" the computer of any variation from the original estimate. The computer recalculates E.T.A.s for all other fix points within the area and automatically up-dates all flight-progress strips. The computer is constantly searching for potential conflicts. Detected conflicts, with alternative resolutions, are portrayed on a Charactron tube for the controller's scrutiny and necessary action.

One of the bottlenecks in the A.T.C. system is the transition/terminal area. This is the area within approximately 90 miles of the airport, or airport complex. As aircraft reach this 90-mile radius, they are taken under positive radar control in three dimensions, and tracking gates are used to carry aircraft identity and other pertinent information along with the target on the controller's radar display. As aircraft approach this 90-mile radius, they are sequenced and scheduled for landing at their destination airports. The diversity of speed and aircraft performance characteristics makes this scheduling function an extremely complex process.

Another important innovation in the Data Processing Central is computer-assisted flow control. Today, aircraft arrive in terminal areas more or less at random. When they arrive faster than the system can accommodate them they must be held in stacks. The new system will organize these arrivals prior to reaching the transition/terminal area and thus minimize the use of holding by the ability to assign a specific landing time at a much earlier moment in time.

The supervisor in the A.R.T.C.C. will have a flow-control panel on his console. Using this, he will be able to look at forecast airport acceptance rates and predicted traffic for the next hour and for the second, third, or fourth hour in future time. Further, he will be able to determine the number of aircraft which are scheduled to arrive at any specific airport within his area of jurisdiction from any adjacent area. Displayed on his panel will be pertinent weather information available for any one of the next four hours. Knowing the forecast airport acceptance rate, the predicted traffic and its origin, the controller will be able to adjust the traffic flow to avoid congestion.

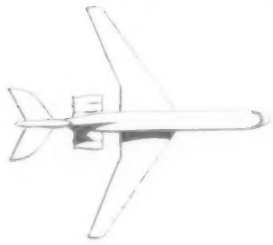
The system, though evolutionary in concept, will need to be thoroughly tested in simulation. Problems will be generated in a simulator and radar information will be fed directly to the D.P.C. The simulator, in addition to testing concepts, will furnish an air-traffic environment to develop training standards for the operation of the new tools provided in the D.P.C. Following these simulated tests, the system will be tried under live-flying conditions with high-density traffic provided through special arrangements with civil and military aircraft.

The ultimate success of any future A.T.C. system will rest, at least in a large part, on the quality, speed and flexibility of automatic ground-air-ground communications. The F.A.A. has a contract with the Radio Corporation of America to develop an experimental two-way, high-speed data link known as the Automatic Ground-Air-Ground Communications System, or AGACS (pronounced "Ajax"). This will provide the tool to determine the parameters for the exchange of essential routine flight information between aircraft and the controller. Non-routine communications will be by voice channel. Surveys

* "Research and Development Program for Future Air Traffic Control Systems," by Capt. Alden C. Packard, U.S. Navy, acting director, Bureau of Research and Development, Federal Aviation Agency.

(*Continued on page 435*)

THE SHAPE OF THE FUTURE



The wing

is free

to do its job

because....

the engines are in the right place

The airline silhouette of the future, with its clean wing and rear mounted engines, offers many important advantages :

- The clean wing has higher lift and lower drag, giving superior airfield performance and better high mach number characteristics
- Full span leading edge lift devices and uninterrupted flaps
- Much reduced fire risks with no tanks or fuel lines in turbine disc areas
- Better performance margins and unique payload/range capabilities
- Greatly reduced cabin noise
- No handling problems in critical engine-out situations
- High-set engines with minimum debris risk
- Simpler maintenance from better systems access
- Reduced engine mounting structural difficulties

For the above, and for many other reasons, rear-mounted engines represent one of the greatest advances in aircraft layout.

VICKERS **VC10**

FOUR **REAR-MOUNTED** ROLLS-ROYCE CONWAY BY-PASS TURBOJETS

VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED WEYBRIDGE SURREY ENGLAND

TGA AT 640

Air Transport . . . .

(*Continued from page* 434)

have revealed that routine flight information accounts for 90% of present-day A.T.C. communications. In an AGACS area, all aircraft share a single channel, but only one aircraft is receiving or transmitting at any one time. However, the ground environment may challenge as many as 250 discretely addressed aircraft per minute. AGACS permits a direct automatic tie-in to the data processor.

Eventually, the improved two-way, high-speed data links will, in effect, allow the controller to peer into the pilot's cockpit. Via the data channel, the computer will have access to indicated airspeed, altitude, information provided by airborne navigational systems, and such other cockpit readings which may be of value to the controller. The wind to which the aircraft is subjected will be easily calculated. These refinements will make possible a much more accurate positioning of aircraft in space and will ultimately lead to a reduction in separation.

Flight plans of the future will, almost certainly, be computer-derived. The pilot will indicate a desire to fly from one point to another and the computer will, in a fraction of a second, plan the best flight-path and deliver a complete flight log to the pilot. In this same fraction of a second, the computer will have reserved taxi, take-off, en route, and landing priorities for the flight. An exact landing time will be assigned before leaving and the pilot will fly the computer-derived schedule provided.

The instrumentation and presentation of flight information in the pilot's cockpit will be modernized. The pilot's task will be one of matching pointers. The importance of proximity warning devices and conspicuity designs will have been relegated to aircraft which are flying VFR in airspace outside the area of positive control. See-and-be-seen flying will only be conducted outside controlled areas.

The Hunting H-107

HUNTING AIRCRAFT, LTD., has been keeping its H-107 short-haul, short-field twin-turbojet design study, started about four years ago, up to date, particularly in relation to engine developments. The advantages of the turbofan (or by-pass) type of engine have been fully appreciated and the latest edition of the design is based on two such engines, instead of the Orpheus turbojets in earlier versions. A development programme for an engine specifically matched to the requirements of the H-107 has been put in hand by Bristol Siddeley Engines, Ltd.

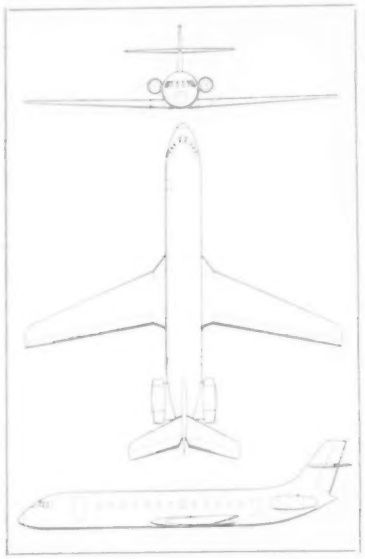
Continuing market assessments by Hunting Aircraft show that the need for such an aircraft as the H-107 still exists, and the project, which in origin is wholly a Hunting concept, is now under consideration by Airco, the de Havilland/Hunting/Fairey consortium. The aircraft is broadly in the category of a Viscount/Convair 340 replacement and as such should interest a wide range of operators throughout the World. It is certainly one of the projects which the Minister of Aviation will need to consider carefully in relation to any change in Government policy towards the financing of new civil aircraft development.

The H-107 is designed along fail-safe lines, with a distributed flange design for the wing structure and a conventional semi-monocoque fuselage with low pressurization stress. Double-slotted flaps are provided, and integral fuel tanks are in the outer main planes. The fuselage has a maximum working differential pressure of 8.0 p.s.i., the system combining air conditioning and temperature control with pressurization.

Pneumatic operation is used for the undercarriage, air brakes, wheel brakes and nosewheel steering. The brakes are disc-type, with anti-skid devices. Thermal de-icing is used on the wing and tail unit.

Normal crew is four—two pilots and two cabin attendants, and normal accommodation is for 48 passengers at 36-in. seat pitch. A radio operator/navigator station can be provided behind the co-pilot at the expense of forward baggage volume; alternatively, radio controls are located centrally in the cockpit roof and can be reached by either pilot. Standard layout provides for a 4 ft. by 3 ft. pantry between the flight deck and cabin, and a 3 ft. 9 in. by 3 ft. toilet to the rear of the cabin.

A display panel on Huntings' stand at the S.B.A.C. Display indicated the operating costs of the H-107 when powered by two Bristol Siddeley Orpheus B.Or.12 turbojets; the use of the newer turbofans is likely to reduce the costs measurably. With Orpheus engines, and carrying 48 passengers (9,900-lb. payload) over a 700-naut. mile sector, the direct operating cost is 1.3d./pass. naut. mile, assuming 2,500 hours annual utilization. With the maximum of 56 passengers (12,000-lb. payload) over 400 naut. miles, the cost is 1.25d. Break-even loads are 50% in each case, or 24 and 28 passengers respectively.



Hunting H-107

Dimensions
- Span: 80 ft. 0 in.
- Overall length: 85 ft. 2 in.
- Overall height: 24 ft. 0 in.
- Gross wing area: 800 sq. ft.
- Sweepback: 20° on 25% chord.
- Internal cabin dimensions:
  - Length (ex. flight deck): 49 ft. 0 in.
  - Max. width: 102 in.
  - Max. height: 74.5 in.
  - Max. usable floor area (ex. flight deck): 415 sq. ft.
  - Max. usuable volume (ex. flight deck): 2,500 cu. ft.

Accommodation
- Normal: 48 (4 abreast).
- Maximum: 56 (4 abreast).
- Volume of freight and baggage holds: 353 cu. ft.

Powerplants
- Two Bristol Siddeley high-flow-ratio B.E.61s.
- Take-off power each (I.S.A., s.l.): 7,000 lb.s.t.
- Provision for silencers and reversers.

Weights and Loadings
- Basic operational: 21,892 lb.
- Total fuel: 17,840 lb.
- Mfrs. max. payload: 12,000 lb.
- Max. take-off: 42,400 lb.
- Max. landing: 40,500 lb.
- Max. zero fuel: 34,700 lb.
- Wing loading (max. t-o. wt.): 53.0 lb./sq. ft.
- Wing loading (max. landing wt.): 51.0 lb./sq. ft.
- Power loading (max. t-o. wt.): 2.96 lb./lb. s.t.

Design Criteria
- Design limit speeds: Mc/Vc=0.78/270 k. Mne/Vne=0.80/280k. Md/Vd=0.85/340 k.

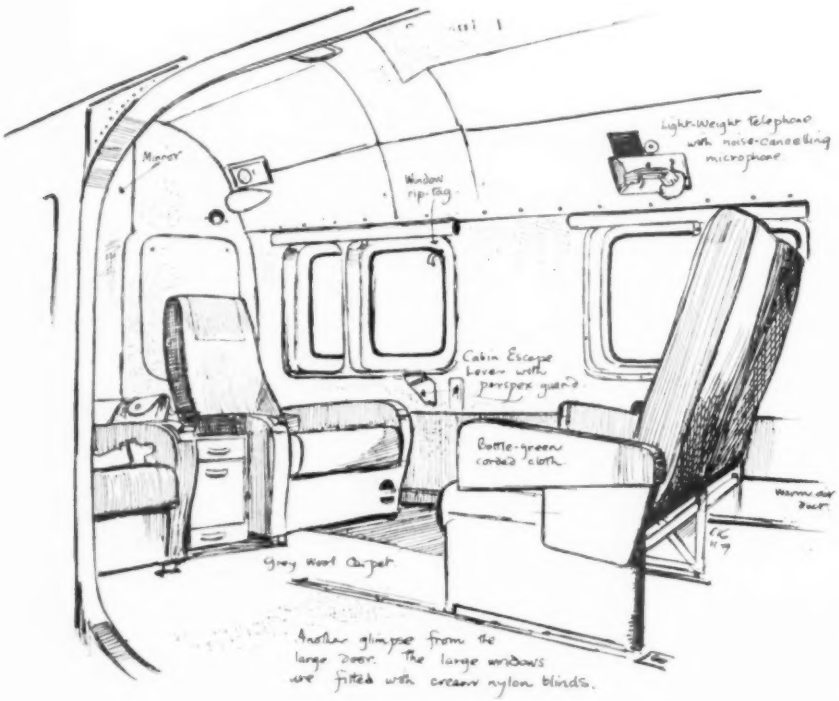
Performance
- Recommended cont. cruising speed (I.S.A.): 440 knots (at 30,000 ft. and 38,000 lb.); consumption: 415 Imp. gal./hr.; approx. 95% max. r.p.m.
- Approach speed (at max. landing wt.): 105 knots.
- Balanced field lengths (at max. t-o. wt.):
  - At I.S.A. at sea level: 3,750 ft.
  - At I.S.A.+15°C. at sea level: 4,200 ft.
  - At I.S.A. at 5,000 ft.: 4,950 ft.
- Landing distance from 50 ft. (unfactored, max. landing wt.): 2,600 ft.
- Range (take-off to landing), still air, no reserves, I.S.A., max. fuel (2,230 Imp. gal.): 2,200 naut. mi. with 2,240 lb. payload at 440 knots (mean) at 30,000 ft. (mean).
- Range (take-off to landing) still air, no reserves, I.S.A., with max. payload: 1,000 naut. mi. at 400 knots.

Helicopters for the Queen's Flight

FOR years now the use of rotary-wing aircraft has become accepted as a useful mode of travel by members of the Royal Family and in particular by H.R.H. The Duke of Edinburgh. Indeed, His Royal Highness is a helicopter pilot himself and makes use of such craft whenever the opportunity arises of utilizing their special characteristics. Now that two Whirlwinds, built for the Queen's Flight by Westland Aircraft, have been completed, even more Royal flights by helicopter can be counted on.

Though there may be a natural tendency to regard these two machines as rather special aircraft, they are in fact special only in having certain extra items of equipment and the sort of interior arrangement and decoration one would expect in a Royal vehicle. So far as the airframe and powerplant are concerned these are standard civil Whirlwind units which are themselves almost identical with those of the Whirlwind HAS.7 used by the Royal Navy. Indeed, the principal difference between the naval and civil machines has been the modification of the underside of the fuselage to provide for the sonar gear and torpedo bay and, in the civil craft, to incorporate more generous windows in the cabin walls and door.

The two Whirlwinds for the Queen's Flight—they are designated Whirlwind HCC.Mk.8—are powered by the Alvis Leonides Major 160 two-row radial which has a power rating of 740 b.h.p. for this application. As we have said, the installation is standard, but for these particular craft the fire detection system, normally using individual detectors, has been changed to one having Firewire—one circuit being located forward of the engine and the other aft of it.

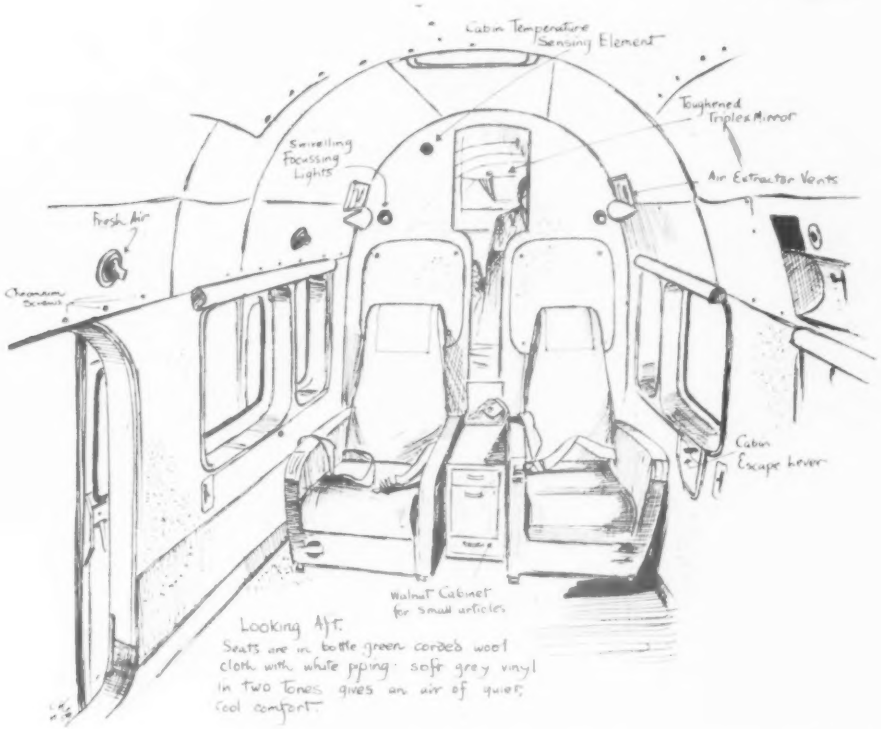

Light-weight telephone with noise-cancelling microphone
Mirror
Window rip-flap
Cabin Escape Lever with perspex guard
Bottle-green corded cloth
Warm air duct
Grey wool carpet
Another glimpse from the large door. The large windows are fitted with cream nylon blinds.

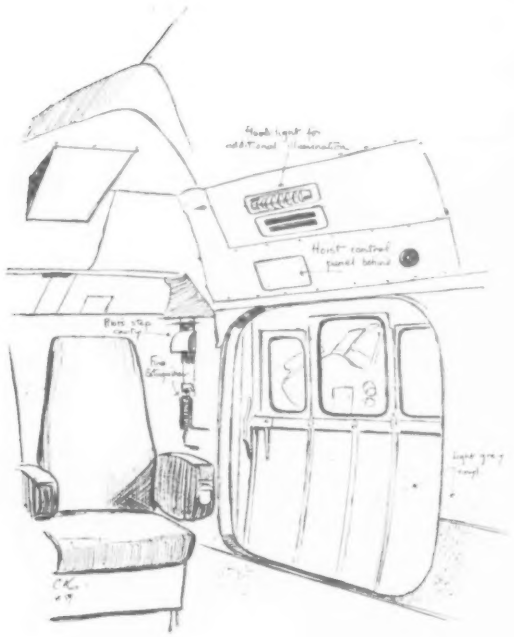
Another added safety precaution has been the installation of a six-man inflatable dinghy in the under-floor portion of the main cabin. This is of the release type which, after having been "jettisoned" by the pilot, automatically inflates and remains attached by a line to the aircraft until released by the occupants.

For the comfort of passengers in these Royal helicopters special attention has been paid to air conditioning and cabin silencing. A heat exchanger on the exhaust manifold, fed by a fan, provides the necessary warm air which can be ducted overboard by a spill valve or distributed to the cabin warm-air grille located on the port side at floor level. The heat exchanger is of the independent type so that a crack or failure of either the exhaust manifold or of the heater duct will not result in CO_2 contamination of the cabin air supply. Control of the cabin temperature is from the flight deck where a temperature gauge is installed on the pilot's panel.

For providing cool air for the cabin, there are two small external ram-air intakes on the starboard side which lead to two individually controlled

The sketches on these pages were specially drawn for us, by Charles King, to show the special cabin arrangements of the two Whirlwinds for the Queen's Flight. The two principal seats face forward from the rear bulkhead.


Cabin Temperature Sensing Element
Toughened Triplex Mirror
Swivelling Focussing Lights
Air Extractor Vents
Fresh Air
Cabin Escape Lever
Walnut Cabinet for small articles
Looking Aft.
Seats are in bottle green corded wool cloth with white piping: soft grey vinyl in two tones gives an air of quiet cool comfort.



louvres of the usual spherical type. There are no corresponding intakes and louvres on the port side of the cabin because the engine exhaust is on that side and fumes might be taken into the cabin.

The method of soundproofing adopted is of particular interest in that it gives a combined protection against external noise and a measure of damping for internal noise. Immediately inside the fuselage skin, between structural members, there are packs of glass fibre encased in a plastic container. Beyond this, inwards, is an air-space followed by another glass-fibre pack, backed by either a solid Vynide sheet or a light-alloy panel in an area where an access panel is required. Inside this panel is another layer of glass-fibre and finally there is the cabin trim proper in the form of a perforated Vynide sheet.

With this type of soundproofing, noise generated outside the skin is mostly absorbed in the first layers of glass fibre and the airspace—the "residue" being reflected back by the metal panel or solid Vynide sheet. Likewise cabin noise is passed by the perforated wall trim to be absorbed in the inside layer of glass fibre.

A most restful and pleasant colour scheme has been chosen for the cabin. This is in two shades of grey—the lighter being on the upper walls and ceiling—with dark green upholstery and white piping for the seats. Entrance to and from the cabin has been made easier by a double step instead of the more usual single one.

For emergency exit, all the cabin windows have the standard quick-release rip; and the rear main window on the port side can be jettisoned complete with frame. The cabin door is also jettisonable for emergency escape.

To permit the maximum possible utilization of these helicopters, four standard seating arrangements have been catered for. The first is the basic four-passenger layout with the two principal seats, of the fully adjustable armchair type, arranged facing forward across the rear cabin bulkhead. Between them is a walnut cabinet for sundries and first-aid equipment; on the bulkhead over the cabinet is a large toughened-Triplex mirror; and individual reading lamps are on the bulkhead behind each seat. Two more armchair seats—non-adjustable and facing forward—complete the accommodation in this version.

As an alternative, the two forward seats can be replaced with two facing aft and located more towards the front of the cabin to give more leg-room; these will be adjustable seats. When the occasion arises six seats can be provided with two forward-facing pairs of seats in addition to the two principal seats at the rear of the cabin. And yet another arrangement is possible by using three airline-type seats against the fore and aft bulkheads and two facing aft at the mid-cabin position.

A telephone is provided for intercommunication between cabin and flight deck since the two spaces are completely separated.

The instrument panel is the standard pattern used for the Royal Navy's Whirlwind 7s. Flight-deck equipment not usually provided in the civil Whirlwind includes the HAS.7-type Dunlop Maxivue windscreen wipers and a windscreen spray system operated normally by the second pilot from a hand pump. Radio equipment includes a stand-by VHF set, the aerial of which is mounted above the fuselage on the starboard side to the rear of the cabin; and a Decca Navigator installed in the equipment bay behind the cabin and having its aerial underneath the fuselage.

Other features of particular interest include the installation of anti-collision high-intensity flashing lamps above and below

the fuselage. As in the case of normal civil Whirlwinds, two electrically fired Schermuly landing flares are housed at the bottom of the fuselage to the rear of the cabin.

An important safety feature incorporated in these Royal Whirlwinds is an extra duplication in the control system. Normally the standard civil version, and some military ones, have a servo-assisted primary control system and an automatic emergency unit for aiding manual lateral control by using pressure from the engine oil system. In the case of the naval Whirlwind 7s a completely duplicated servo control system is used with two quite separate pumps driven from the main gearbox and transmission system.

The Whirlwind HCC.Mk.8 has the fully duplicated system plus the automatic emergency servo-assisted system for lateral control. It is also provided with means for selecting full manual control for training purposes, but in this instance will retain the emergency lateral assistance.

For use as required in special circumstances, both these helicopters for the Queen's Flight are equipped with the latest self-contained winch and hoist. This is externally mounted on four bolts—so that it is removable when not required—and uses a hydraulic motor.

Externally there is little to see in the way of differences between the HCC.Mk.8 and other civil Whirlwinds. The colour scheme selected is dark blue topsides with silver underneath and separated by a thin red line. This looks very smart. In addition, the overall appearance of the craft has been enhanced by the deletion of all external painted instructions save those connected with emergency notices.

One other interesting point about these two helicopters is that it has been possible to cater for all the various loading arrangements with a fixed amount of ballast in the tail-cone and tail-skid. This will much simplify operation of the craft, for it obviates the necessity to adjust ballast according to load in order to get the right trim.

Both these Whirlwinds will be based with the other aircraft of the Queen's Flight at R.A.F. Benson where the Flight has its headquarters. They will be flown by R.A.F. pilots and maintained by R.A.F. personnel. Their introduction will greatly enlarge the scope of an already versatile Flight. No doubt they will be in great demand in Royal service.

The Royal Whirlwinds have a standard naval instrument panel.

Demonstrating the Bristol 192's Potential

AN interesting practical demonstration of the load-lifting potentialities of the Bristol Type 192 twin-engined tandem-rotor helicopter was given recently near Cambridge as reported in THE AEROPLANE AND ASTRONAUTICS for October 23.

This exercise was, in fact, a development flight which became a demonstration and, at the same time, had the very real virtue of performing a useful job of work. It involved an airlift of a parabolic aerial for a radio telescope (part of the equipment of the Mullard Radio Astronomy Laboratory of the University of Cambridge) from its former site at Grange Farm, which is about one-and-a-half miles west of Cambridge, to a new site some six miles "as the helicopter flies" across country.

Since this aerial weighed little more than 2,000 lb., the weight was not an important consideration. However, the aerial's size—it was 26 ft. in diameter—made it impossible to move by road. Dismantling and re-erection on the new site, quite apart from the trouble and time involved, was not a practical proposition because of the corrosion sustained by many years of exposure, some of them as far back as the late War, when the apparatus started life on the coast of Europe for a rather different purpose.

All this made it ideal cargo for a helicopter, although its fragile structure obliged us to use "treat like eggs" care. Its shape, very similar to a parachute, also made it subject to high drag, both from the rotor downwash and from forward flight.

Drag arising in forward flight could, of course, be limited by keeping the speed down, since the distance involved was so short that speed was unimportant. It was predicted that at 30 knots the angle of trail would be about 30° and if this was so, the drag would be in the order of 2,000 lb.—i.e., equal to the weight. In practice, this estimate proved substantially correct and although an airspeed of 45 knots was occasionally exceeded, this speed was found to provide the most comfortable condition for cruising flight.

Although forward speed can always be varied to suit any particular load, the initial hovering lift is a necessary obstacle, and for this exercise a very accurate vertical lift was essential, because if the dome had been tipped on its rim it would certainly have been damaged. Here, the tandem configuration of the 192 was a tremendous asset—both from the control aspect and because of the, often forgotten, fact—in contrast to most other helicopter configurations—that the downwash from a tandem helicopter's blades is not concentrated vertically over the load it is trying to lift.

If we had been able to park the helicopter alongside the load or even at a nearby aerodrome and await a day when everybody was ready and suitable weather conditions prevailed, the operation would have been considerably easier. As it was, we could not possibly spend more than one day on the project. Furthermore, that day had to be named in advance.

Last but not least, the helicopter had to fly from Weston-super-Mare to Cambridge to do the job, and back again on the same day—a distance of some 300 miles. Careful planning was therefore called for and this was made in conjunction with the Air Ministry under whose auspices the operation was carried out.

The whole exercise was in fact successfully completed before lunch, which turned out to be a convivial affair in Downing College. The flight back to Weston-super-Mare was as uneventful as it was comfortable.—C. T. D. HOSEGOOD*.

*Chief helicopter test pilot, Bristol Aircraft, Ltd.

The Fighting Services

Air Rank Appointments

AIR MARSHAL SIR WALTER H. MERTON, K.C.B., O.B.E., is to become Air Member for Supply and Organization on April 8, 1960, in succession to Air Chief Marshal Sir Walter L. Dawson, K.C.B., C.B.E., D.S.O., who will be retiring from the Service. Chief of Staff, Allied Air Forces Central Europe, since February, 1959, Air Marshal Merton was previously Air Officer in Charge of Administration at Headquarters, Bomber Command.

The appointment of Chief of Staff, Allied Air Forces Central Europe, is to be taken over by Air Vice-Marshal D. G. Morris, C.B., C.B.E., D.S.O., D.F.C., with the acting rank of Air Marshal, in February, 1960. Air Vice-Marshal Morris has been Assistant Chief of the Air Staff (Air Defence) since April, 1957, before which he was S.A.S.O., 2nd T.A.F.

Air Marshal Sir Walter H. Merton, who is to succeed Air Chief Marshal Sir Walter L. Dawson as Air Member for Supply and Organization at the Air Ministry next year.

Oman Honours

IN the London Gazette for October 27 was a list of awards to R.A.F. personnel for recognition of service in Oman.

A bar to the D.F.C. has been awarded to Wg. Cdr. J. C. Graham, and the D.F.C. has been won by Wg. Cdr. B. W. Parsons, A.F.C., and Plt. Off. J. H. Martin. Flt. Sgt. P. Boniface, A.F.M., receives the D.F.M. Six officers, Sqn. Ldr. T. R. Holland, Flt. Lts. J. H. Besant, D. S. Burden, K. D. Jefferies and R. R. Kennedy, and Flg. Off. C. F. White, have been Mentioned in Despatches.

R.A.F. Thorney Island

THE R.A.F. station at Thorney Island between Chichester and Portsmouth is 21 years old this year. An historical record of this period is being compiled and the present staff would be grateful for any information, photographs, anecdotes and facts from past members of the station, particularly those who served there during the War years.

All photographs will be carefully handled and returned if required. Historic material should be addressed to Flg. Off. D. Barnes, R.A.F. Thorney Island, Emsworth, Hampshire.

Light Aircraft Flying

A ROLLASON-BUILT Turbulent ultra-light has, at the request of the Commandant, Air Cdre. J. N. H. Whitworth, D.S.O., D.F.C., been lent to the Central Flying School, R.A.F. Little Rissington, for use by the pilots at the station. The loan was negotiated by two members of the Tiger Club, Sqn. Ldr. J. de M. Severne, A.F.C., Equerry to Prince Philip, and Plt. Off. B. McDonald of C.F.S.

After three weeks at Little Rissington the Turbulent will be on loan to R.A.F. Wattisham, where it will be flown by members of No. 111 Squadron.

Fighter Command Photography

LAST week Fighter Command held its first Annual Photographic Competition at R.A.F. Bentley Priory. The judges were Air Vice-Marshal R. B. Lees, S.A.S.O., at Command Headquarters; Mr. E. Freeborn of the London Polytechnic; Mr. G. Phelp of Marconi's; and Wg. Cdr. G. Greenfield, Photo Specialist Officer, Central Fighter Establishment.

It was considered that the general standard of entries was high, and some prize-winning entries exceptional especially considering the restrictions imposed by the use of Service equipment and materials. Ground-to-air photography was extremely good. Criticisms were that those entries of poorer standard had been spoiled in print finishing.

Some photographs in the workshop activity class lacked action, which spoiled otherwise technically good negatives and prints. Whilst photography on public relations and sport were sometimes lacking in imagination it is considered that an improvement will come with the introduction into Fighter Command of the Microflex camera, allowing the photographer greater mobility than is generally possible with the Micro Technical camera.

A shortage of entries in the air photography section was anticipated, because of the rôle of the Command where aerial photography is in general restricted to air-to-air ciné and camera guns. Again it may be possible that entries will increase with the introduction of a lightweight camera which may be used from the back seat of training aircraft. This section of the competition did not count in the inter-station competition.

The best individual performance award went to Cpl. Attenborough of R.A.F. Old Sarum. R.A.F. Leuchars won the inter-station cup, with R.A.F. Stradishall second and R.A.F. Duxford third.

R.A.F. Appointments

THE following are among recent Royal Air Force appointments:—

Bomber Command: Wg. Cdr. F. C. D. Wright, D.F.C., to Headquarters for operations duties.

Fighter Command: Wg. Cdr. J. H. Spencer, M.B.E., to the Signals Trials Team at Headquarters Unit; Wg. Cdr. J. Harvey to No. 228 Operational Conversion Unit at R.A.F. Leeming as Senior Technical Officer; Wg. Cdr. J. W. J. Leggett to Headquarters in charge of training; Sqn. Ldr. H. E. Bennett to Headquarters for electronic planning duties with the acting rank of Wg. Cdr.; Sqn. Ldr. D. W. H. Smith, A.F.C., to R.A.F. Wattisham to command No. 41 Squadron with the acting rank of Wg. Cdr.; Sqn. Ldr. R. J. S. Spooner, A.F.C., to R.A.F. West Raynham to command the Fighter Combat School with the acting rank of Wg. Cdr.

Coastal Command: Gp. Capt. J. Avent, D.F.C., to R.A.F. Kinloss to command; Wg. Cdr. A. G. Evans to Headquarters as Deputy Command Signals Officer.

Transport Command: Wg. Cdr. J. F. Ratcliffe to R.A.F. Lyneham as Senior Technical Officer.

Flying Training Command: Wg. Cdr. R. H. Blackmore to R.A.F. Church Fenton as Permanent President of Courts Martial.

Technical Training Command: Wg. Cdr. H. Arden to R.A.F. Bircham Newton to command the Administrative Apprentices Training School.

Middle East Air Force: Wg. Cdr. C. W. McN. Newman, D.F.C., to R.A.F. Episkopi to command.

Far East Air Force: Gp. Capt. E. V. Stokes, C.B.E., B.Sc., to Headquarters as Command Signals Officer.

R.A.F. Germany: Gp. Capt. G. H. Goodman, D.S.O., D.F.C., and Sqn. Ldr. J. K. Rogers to Headquarters, with the acting rank of Wg. Cdr., both for Air Staff duties; Sqn. Ldr. J. G. Croshaw, A.F.C., to R.A.F. Geilenkirchen to command No. 11 Squadron with the acting rank of Wg. Cdr.

Other Appointments: Gp. Capt. W. N. Kenyon, O.B.E., A.F.C., to Headquarters Allied Air Forces Northern Europe as Assistant Chief of Staff, Logistics and Administration; Wg. Cdr. D. J. Devitt to be Air Attaché, Buenos Aires, with the acting rank of Gp. Capt.; Wg. Cdr. R. L. Easterbrook to command No. 15 Joint Services Trials Unit.

More Service News

Record Year.—United Kingdom-based Whirlwinds and Sycamores of Nos. 22 and 228 (Search and Rescue) Squadrons dealt with 241 rescue incidents between January 1 and the official end of summer on September 21. Of the total, 173 incidents involved boating, bathing and other close-to-shore mishaps and in every case concerned civilians, of whom 35 were either rescued from the sea or assisted to safety from precarious positions on the shore.

Brooke-Popham Trophy.—Wg. Cdr. D. W. Densham of the R.A.F. Technical Branch has won the 1959 Brooke-Popham Memorial Trophy award at the R.A.F. Staff College, Bracknell. The subject for this year's essay was the military importance of artificial earth satellites.

Antarctic Service.—Sqn. Ldr. K. A. C. Wirdnam, a staff officer at Headquarters, Flying Training Command, is on his way to the South Pole as an observer with the United States expedition "Deep Freeze V." He will be the first R.A.F. officer to spend a summer with the American task force in the Antarctic.

Squadron History.—Flt. Lt. J. A. Brothers is at present compiling a history of No. 51 Squadron and would like to hear from ex-members who could supply information and photographs of historical interest. Correspondence should be sent to him at R.A.F. Watton, Thetford, Norfolk.

Helicopter Markets in Italy

By T. D. Calnan

MOST noticeable in Italian aviation circles today is the active commercial interest in the helicopter as a means of transporting passengers and freight. Certain intending helicopter operators are now completing their detailed studies of the problems imposed by their chosen field of operations and are looking critically at the various helicopters available for their purposes.

The two societies which comprise the most immediate market present a remarkable contrast, in that each is planning to use helicopters to resolve a completely different problem. The Societa Elipadana of Milan intends to exploit a highly industrialized and densely populated area, which also has a large seasonal movement of tourists. Linee Aeree Sarde intends to use the helicopter to help develop and rebuild the economy of the island of Sardinia.

Milan is a prosperous and busy city of 1,385,000 inhabitants. Situated in the middle of the great fertile basin of the Po river, it is the business capital and geographical centre of Italy's rich industrial north. Fifty miles to the north are the Italian lakes and the Alps; 70 miles to the south, over the northern spine of the Apennines, lie Genoa and the Italian Riviera; 150 miles to the east, Venice and the Adriatic; Turin and its great industries are 80 miles to the west.

The Comune (City Government) of Milan believes that the time has come to make use of the helicopter to supplement the already overloaded road and rail communications system and to provide, for the professional man, the tourist and eventually for merchandise, a more rapid and convenient form of transport.

In July, 1959, therefore, the Comune of Milan formed the Societa Elipadana; 50% of the shares of the company are owned by the Comune; 25% by an association of all the great industries whose names are household words in Italy (Montecatini, Edison, Falk, Snia Viscosa, etc.), and the remaining 25% by the Cassa di Risparmio. Very broadly, Elipadana's plans are to interconnect all the major centres of population and industry, Turin (890,000 inhabitants), Genoa (736,000), Milan, Verona (200,000), Venice (336,000), Bologna (400,000) and to connect the centres of population with the resorts on the Italian and Adriatic Rivieras and on the lakes in summer and with the mountain resorts in winter.

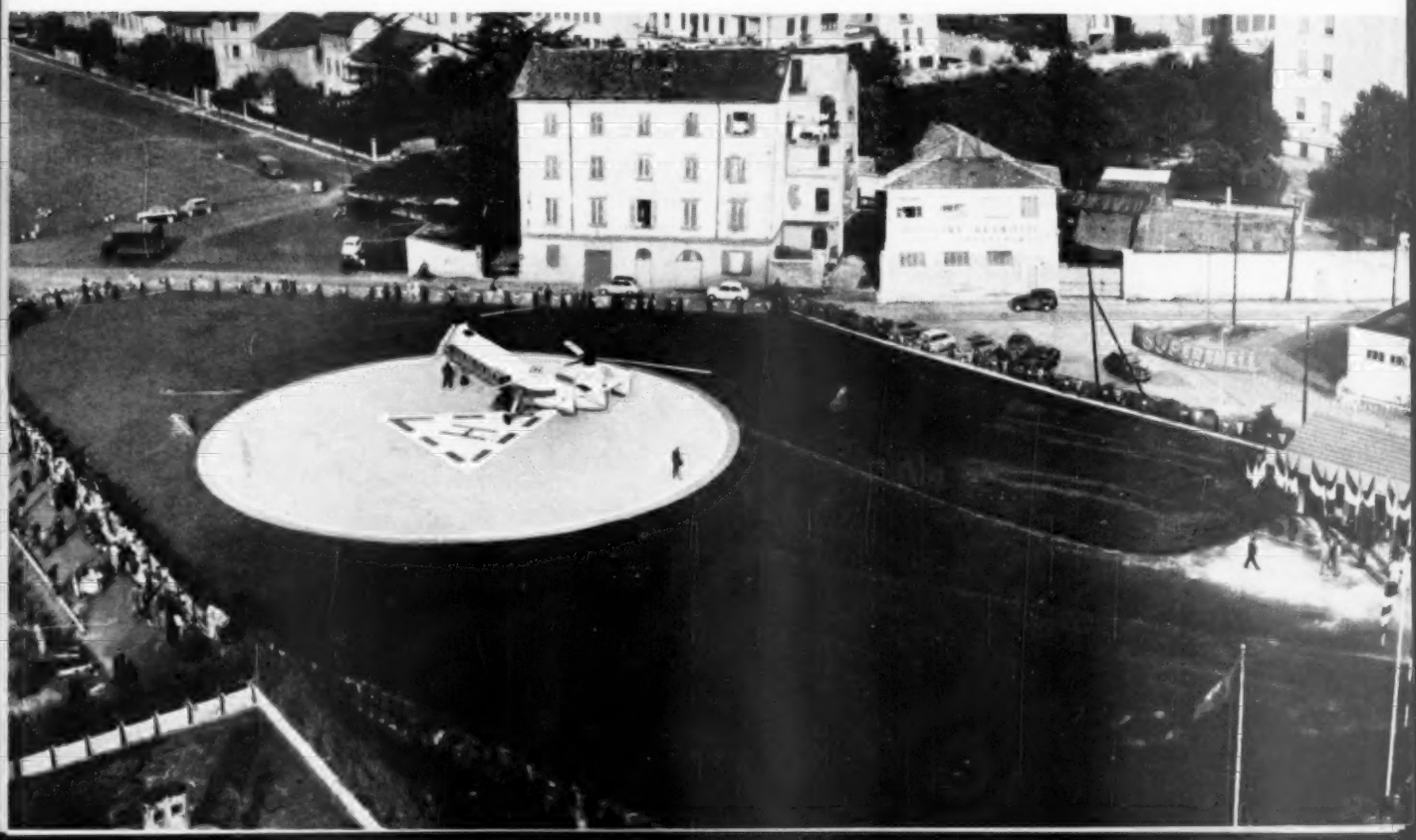
Elipadana are at present engaged in costing their projects in detail and gathering data obtained from running a number of experimental flights along various possible routes of the many they can establish. At present Elipadana are using a chartered Vertol 44 to run a two-month experimental service between Lugano, on the lakes, Malpensa the city airport and the heliport in the city centre, 46 kilometres away. They have also used a Sikorsky S-62 to carry out highly publicized flights on two of their intended summer routes, namely, Milan-Elba, a most popular island resort, and Milan-Verona-Venice.

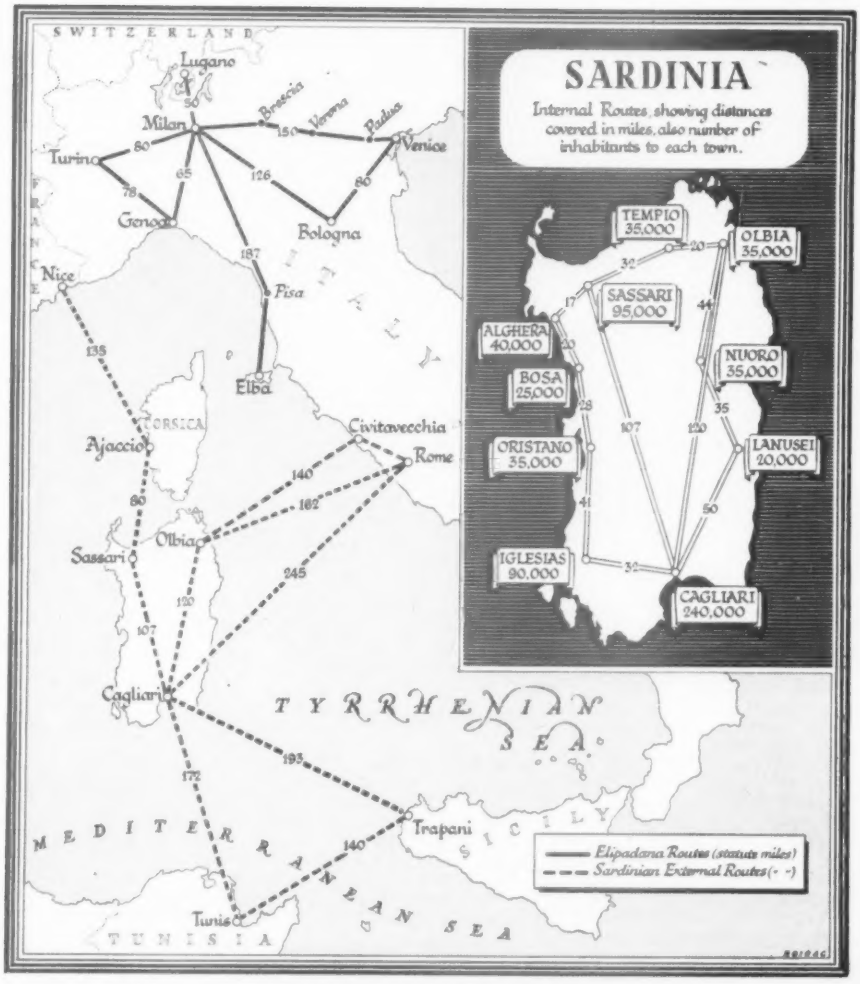
Apart from providing Elipadana with factual data on which to base their costings, these trial flights are also intended to arouse popular interest and support for Elipadana's plans, a facet of the overall problem which the City Comune considers is of the greatest importance. The choice of helicopter for these experimental flights has a limited significance. Certainly it is the clearest of indications that Vertol and Sikorsky are making every possible effort to win this market. Equally certain is it that Elipadana have not yet made their final choice. Their requirement is for a twin-engined helicopter, with as large a passenger capacity as possible and low direct operating costs. They make no secret of this. As the Italian manufacturers have nothing to offer in this class, Elipadana's choice is probably limited to Sikorsky, Vertol, Fairey and Westland.

The second market for helicopters is in Sardinia. To understand the problems facing Sardinia today, it is necessary to know a little about its history.

In its most prosperous days, before the Roman invasion in 238 B.C., Sardinia had no less than 16 major ports and some 80 smaller coastal towns. Only one of these, Cagliari, survived. The rest were abandoned and disappeared. Since then subsequent occupiers have seldom been beneficient.

The population of Sardinia today is 1,400,000 and the island has deliberately and with great determination, embarked upon an economic revolution. The aim is to exploit the island's great natural riches, to repopulate the coasts and coastal plains and to revert to a natural, largely maritime economy. Since the last War, malaria, which had invaded the coastal plains after their abandonment and prevented any move back to those regions under an occasional more beneficient occupier, has been eradicated. Also since the War, nine new ports have been con-





Helicopter services in Italy fall into three sections. First, is the plan of the Societa Elipadana to open up Northern Italy. Next comes the plan of Linee Aeree Sarde to use helicopters to improve communications between Sardinian centres of population. Last are the links with the mainland of Italy, France and North Africa.

In Northern Italy the Societa Elipadana is planning to use helicopters to exploit this highly industrialized and densely populated area in which, in addition, there is a large seasonal movement of tourists. In this view of Milan's city centre heliport a Vertol 44 is in the landing circle.

structed bringing the island's total to 12. Rich mineral deposits, which have not been mined for centuries are being exploited and hopeful exploration for oil is being carried out. The Sardinians have a great faith in themselves and their future and are making intense efforts and spending much money to reshape their economy.

One essential to all these brave plans is the establishment of good communications, both internal and external, to suit this new economy. It is in this segment of the overall picture that Linee Aeree Sarde has its place.

With the support of the autonomous Sardinian Government, Linee Aeree Sarde is planning to establish regular helicopter services within the island. These will commence as soon as the helicopters are available—probably next summer. The routes are as shown on the map. Daily services, at an as yet undetermined frequency, will circulate round the island in both directions. After these services are established, within a period of three years, external connections will be established with the Italian mainland, the south of France, Tunis, Sicily and eventually, Spain via the Balearic Islands. Sardinia is fully aware of the potential importance of her central position in the Western Mediterranean and is determined to exploit it. The distances involved, as shown on the map, are of the order which make the use of helicopters a practical proposition.

Internal communications in Sardinia are poor and must be immensely improved if internal trade is to develop and Sardinian produce is to reach its markets and ports. Linee Aeree Sarde, whose directors are both pioneers and visionaries, believe in the helicopter as the answer to Sardinia's communication problems. To over-simplify their basic argument, they say this: "If it costs 200 million lire to build a kilometre of road, and if for that money you can buy a big helicopter, why not buy helicopters and use the sky?"

L.A.S. have not overlooked the fact that, to exploit the helicopter to the full, it must be able to operate from the centres of the towns it is serving. Heliports have therefore been sited in all the main towns in Sardinia and the purchase

of sites will be effected with the assistance and authority of the Sardinian Government.

The island has a considerable and growing tourist trade. The establishment of external helicopter communication will increase this trade and the internal services will encourage it. The majority of visitors to the island arrive at the port of Olbia, in the north-east corner, from Italy. To reach the popular holiday resorts in the south, they are faced with a tedious five-hour train journey to Cagliari. Air passengers arrive at the airports of Cagliari, the capital, or Alghera in the north-west. They, too, are then faced with a difficult and tedious journey to reach their final destinations. L.A.S. helicopters, operating from and through Cagliari, Alghera and Olbia, will provide them with a rapid and convenient means of transportation.

L.A.S. will probably commence their internal services next summer with the Agusta 102, carrying eight passengers. But Agusta deliveries are falling behind promised dates and even this is not certain. For their external services, L.A.S. requirements are almost exactly the same as Elipadana's—a large-capacity twin-engined helicopter. Initially, the requirement will be for a minimum of three. As, however, these larger helicopters will be more economical to operate, and also in the interests of standardization, it is logical to expect L.A.S. to start using the larger helicopters on their internal routes also, as they become available. The main preoccupation of L.A.S., at the moment, is to find a suitable twin-engined helicopter, at a suitable price and sufficiently low operating costs, available for delivery in 1963/64.

What, then, is the real interest of this market for British manufacturers of helicopters? Put as bluntly and as briefly as possible, the situation is this. Both Elipadana and Linee Aeree Sarde have taken a great and detailed interest in the Fairey Rotodyne and the civil version of the Westland Westminster. A proved production version of the Rotodyne prototype seen at Farnborough, if available for delivery by 1963/64, could be sold today in Italy by the half-dozen. But an improved version of the Rotodyne, with Tyne engines and an increased passenger capacity, available in 1966/67, is not even of academic interest.

Almost the same can be said for the civil version of the Westland Westminster. Elipadana and L.A.S. are both much attracted by the estimated direct operating costs, performance and capacity of the civil version Westminster. But neither concern will buy a project. If Westland are prepared to put one of their many projected variants of the civil version Westminster into the air and prove it, and if they are also able to promise a delivery of the production aircraft by 1963-64, without increasing their present estimated prices, then they can have this market for the asking.

By 1963-64 there will be two large fleets of big twin-engined helicopters commencing regular services in Italy. This is as certain as progress. Orders for these helicopters will be placed within 12 months and possibly much sooner than that. Today, the British manufacturers have nearly as good a chance of winning those orders as their U.S. competitors, because entries for the race are still being accepted. But the lists are about to close and, unless they make a very determined and directed effort, British manufacturers will not even be starters in this race for a remarkably worthwhile market.

Alongside a Vertol 44 at Milan's heliport are centre, the general manager of Societa Elipadana, Av. Dino Mattoli and behind him, on left in uniform with three stripes, is Commandante de Agua, chief helicopter pilot to S.E.

The market is not restricted to L.A.S. and Elipadana only. They are the pioneers and their choice will influence the buyers who will appear later in the time scale. The most important of these is Elivie, subsidiary of the state-subsidized Alitalia. At present, Elivie is sitting on the fence and saying nothing. But when L.A.S. and Elipadana start operating, Elivie will be forced into activity. The great territory of central Italy, with routes radiating from Rome, has to be exploited and it is Elivie's responsibility. What L.A.S. and Elipadana order tomorrow, Elivie will probably order the day after tomorrow.

Here, then, is the market and here the challenge. I hope that British industry can take it up.

The Sikorsky S-62 has been used by the Societa Elipadana for demonstration flights between Milan and the Island of Elba, also to link Milan with Verona and Venice.

ROLLS-ROYCE BY-PASS JETS

are now flying in Boeing 707-420 and Douglas DC-8 jet airliners

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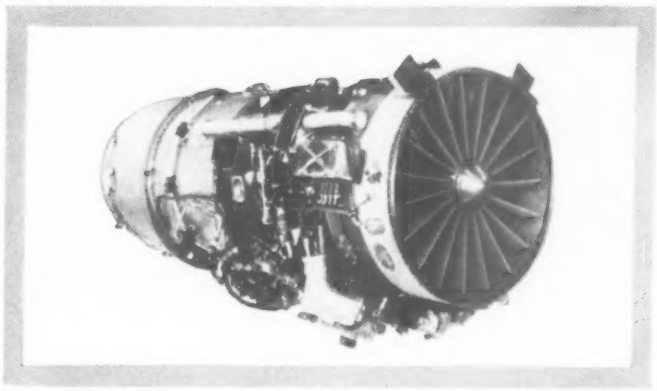
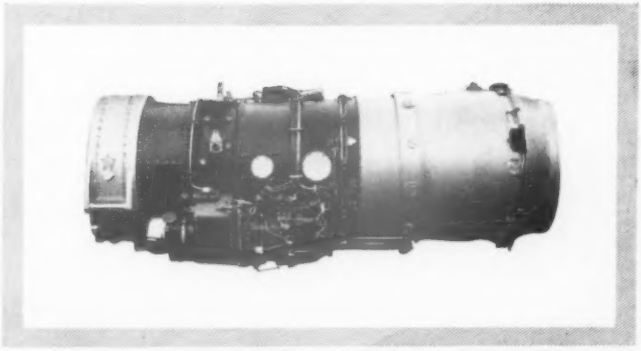


Conway by-pass jets for civil use will enter service in 1960 at 17,500 lb. guaranteed minimum thrust. The Civil Conway is being developed to powers over 20,000 lb. thrust with improved fuel consumption.

The RB. 141 family of by-pass jets (10,000 lb. to 17,500 lb. thrust) have been designed to give the best possible operating economics for jet transport aircraft. The RB.141 of 14,300 lb. thrust will power later versions of the Sud-Aviation Caravelle and the RB.163 of 10,100 lb. thrust has been chosen to power the Airco DH.121.



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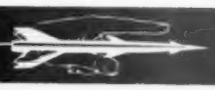


Personal Flying

Flying the Cessna 172

by John Fricker

Photograph copyright "The Aeroplane and Astronautics"

THE American Cessna company produces more light aeroplanes than any other concern in the World, and sells somewhere around 300 of them per month. A small proportion of these are twin-engined executive types; the remainder are all high-wing all-metal strut-braced monoplanes with accommodation for 2-5 people and with engines ranging in power from 100 to 260 b.h.p.

Apart from the tailwheel Cessna 180, the Models 150, 172, 175, 182 and 210 all have tricycle undercarriages with the Cessna-patent spring-steel main legs, and differ only in overall dimensions and individual detail. To fly one, therefore, is for practical purposes to fly all. As I had assessed the Model 180 some time ago, the opportunity of exploring the first Cessna 172 to reach this country was particularly welcome to gain representative experience of this best-selling range.

It seems that the 100-b.h.p. two-seat Model 150 is the most popular aircraft of the Cessna line, and this ties up with its position as the cheapest. With four seats, and a 145-b.h.p. Continental O-300-A flat-six engine, the little Cessna 172 comes next in size and price, costing $9,250 in standard form in the U.S., and £4,352 by the time it reaches this country, including import duty and delivery charges. With radio, ADF, VOR and a single-axis autopilot, G-APSZ, the first British example, cost slightly more than £6,000.

It was bought, via W. S. Shackleton, Ltd., by Mr. Edward Drewery, who has a half-interest in the company operating Biggin Hill, where I flew G-APSZ through his courtesy. A 1959 model, it had only 79 hours on the recorder—incorporated in its tachometer—and was thus barely "run in." Mr. Drewery had just brought 'SZ back from a tour of the Continent, where its excellent slow-flying qualities had proved particularly valuable in bad weather.

One of the main features of the Cessna range, in fact, is the provision of very powerful slotted flaps, in contrast to many other American types which are slightly underflapped. Just as the spring-steel tricycle gear is trade-marked "Land-o-Matic," so these flaps are "Para-Lift"; and they certainly do avoid lift, to take a literal translation, when fully extended. The high-wing Cessnas, therefore, have a particularly good short-field performance, with less emphasis on high cruising speeds.

Construction is entirely of metal, including control surface covering, and the NACA 2412-sectioned wing has a single bracing strut on each side. A 17½-gal. fuel tank is housed in each wing-root, with individual panel gauges, and there is a selector lever on the floor between the front seats. These are both adjustable for leg length, and for easy access through the car-type doors on each side of the cabin.

Entry is assisted by a small step on the maintenance-free spring-steel main undercarriage legs, on which the Cessna 172 sits fairly close to the ground. The doors have flush-fitting external handles, in keeping with the general cleanliness of the airframe, and on the port side, the entire window can be opened outward on its upper hinge.

Cabin furnishings are in the usual comfortable American automotive style, with an excellent standard of finish, to match the "jet-styled" white-topped exterior paint scheme. The attention paid to comfort is not at the expense of functional utility, and there is a sensible instrument layout on the deep flight panel.

Although complete dual flying controls are installed, flight and engine instruments are concentrated in front of the left-hand seat, with VHF selectors and ADF box below the push-pull handwheel. The VOR and radio compass dials are above the centre panel, and the right-hand side is clear except for a strip of engine instruments and a large glove compartment.

Perhaps the only inconveniently located control in the Cessna 172 is the parking T-handle for the toe-operated disc brakes. This is immediately under the starboard handwheel shaft, where it is extraordinarily difficult to get at from the left-hand seat.

In the corresponding position on the left is the engine starter handle, which after a long pull brings the Continental into well-muffled life. It is unusual to find a six-cylinder engine in such a relatively low power bracket, but the result is an exceptionally smooth powerplant.

The closely cowled American light aircraft engines require very little warming-up. Recommended procedure is to begin taxi-ing immediately after starting.

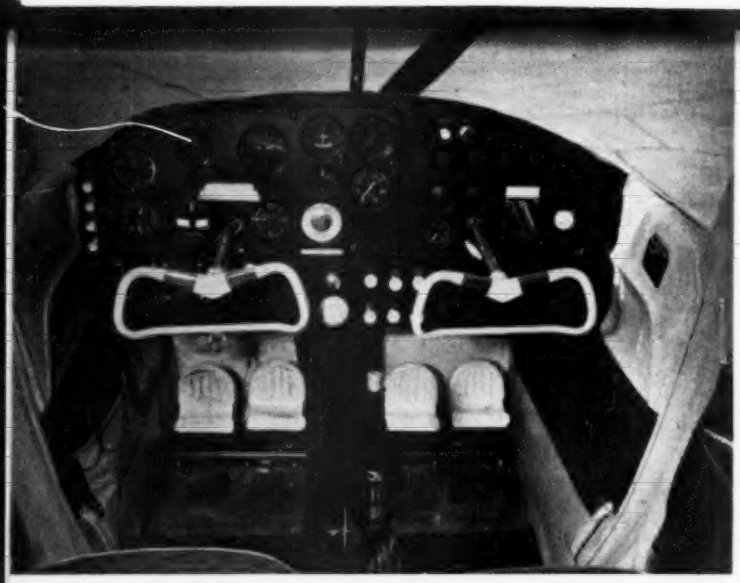
In the Cessna 172, it is first necessary to remove the simple but effective control lock, which comprises a sort of oversized safety-pin through the port handwheel shaft and a dashboard collar. As the nosewheel is directly coupled to the rudder pedals for ground manœuvring, no rudder lock is necessary, and the sturdy front oleo strut steers through an arc of 16° with moderate foot pressure. For tighter turns, a touch of toe brake will cause it to castor up to 30° each way.

Having sorted out the cockpit with the help of Maitland Air Charter's Mr. Waterhouse, who had the operating handbook in the right-hand seat (he had flown the 172 only once before), I moved off round the perimeter track at Biggin Hill, to line up on the short runway. Taxi-ing the Cessna, with its excellent view and simple steering, is so much like driving a car that some of its pilots start fumbling for a gear lever. Ground stability is exceptionally good. The fuselage-mounted main-wheel legs give an adequate track and a pleasantly sprung ride, while the nosewheel is sufficiently far forward to minimize pitching on rough grass.

For take-off, I used the first notch of flap (10°) via the press-button-capped manual lever between the front seats. The indicator of the adjacent elevator trim wheel was in the green section of its arc, and after a brief run-up we were all set to go. The 172 has a fixed-pitch airscrew, but with two up and about three-quarters fuel, acceleration was rapid and smooth on opening the central plunger-type throttle.

We were more or less into a light wind, and a touch of right rudder kept us straight as we reached full power at 2,700 r.p.m. Very little aft wheel pressure was needed for a smooth unstick at about 60 m.p.h. I.A.S., after a short ground run, and the 172 climbed vigorously away at just under 80 m.p.h., indicating about 1,000 ft./min.

The best angle of climb is achieved at 60 m.p.h., but at the higher speed, the ascent path is still commendably steep.



The Cessna 172 cockpit is pleasantly laid out, with dual flight controls. The T-handle below the left-hand panel is for autopilot engagement, with a turn control knob in the centre of the dash.

Like all low-powered aircraft, the Cessna 172 is sensitive to load, and with four up, the initial climb falls to about 660 ft./min.

I climbed straight up to about 5,000 ft. above the haze line for some air-to-air photography, holding a little right rudder against the full-throttle power, and exploring control response before essaying some formation flying. The feel of the Cessna was typically American, with pleasantly effective controls allied to good stability. Analysed individually, the ailerons proved a little soggy, although light at all times, with the elevator and rudder matching each other for a slightly heavier positive response.

Moderate longitudinal trim changes accompanied alterations in power or speed, and were effectively handled by small movements of the low-geared trim wheel. This proved a much better control than some of its kind in American light aeroplanes.

In the air, forward view through the deep windscreen is excellent even when climbing, the pilot's eye-level being fairly high above the sloping engine cowling. This position also brings one in line with the wing-root level, but the Cessna is no worse than other high-wing aircraft in its restricted lateral visibility during turns.

Throttled back to 2,400 r.p.m. the 172 indicated about 110 m.p.h., which trues out at 113 m.p.h. at 5,000 ft., for a consumption, in lean mixture, of 6.3 gal./hr. This consumption figure can be further reduced to 5 gal./hr. at 2,200 r.p.m., which gives a T.A.S. of 100 m.p.h. So although the Cessna 172 is by no means as fast as its more rakish American brethren, it is as economical, and can be cruised at 124 m.p.h. T.A.S. at 2,650 r.p.m. and 10,000 ft.

It is ideal, in fact, for the less ambitious or inexperienced private pilot, and of course it is aimed in the United States at the flying businessman. It conveys an impression of comforting solidity, and is so docile and easy to fly that it is difficult to envisage anyone getting into trouble through mishandling it. In rough air, it did seem to "snake" slightly, directionally, possibly because of its over-generous vertical tail area.

After its cruising tractibility had been proven during the photographic session, I used the let-down period to explore the low speed performance. Closing the throttle resulted in a nose-down trim change which necessitated increasing back pressure on the wheel to counter as speed decreased. The stall-warning horn began bleating at about 40 m.p.h., which is the lowest figure on the A.S.I., and with the wheel hard back, the nose began to oscillate up and down gently as the needle moved back towards the mark for 30 m.p.h.

Aileron control remained in some form down to the lowest speed, although there was virtually no natural stall warning, and with flap up, a fully developed stall was almost impossible to obtain. With the full 40° of flap, and a little power, the Cessna really sat up and begged, and the stall-warning horn did not start to sound until the airspeed went "off the clock." By really determined back pressure on the wheel, it was then possible to reduce speed further until an abrupt breakaway followed, with a smart drop of the port wing and nose.

Very little height was needed for recovery, however, and it would seem extremely difficult to stall the 172 inadvertently. As long as the A.S.I. records something, in unbanked flight, the Cessna will not stall, although it must be remembered that position error correction in the full-flap case is +12 m.p.h. This seems rather a lot, especially as the stalling T.A.S., clean, is 58 m.p.h., instead of somewhere around 40 indicated.

In a 40° turn, with full flap, the stalling speed increases to 60 m.p.h. T.A.S., but there is apparently no tendency to spin. It came as a slight surprise, on consulting the handbook, to find that the 172 is cleared for spinning, but this was not explored during my handling flight. With two persons on board, the load factors are +4.4 and −1.76*g*, reducing to the normal +3.8 and −1.52*g* at maximum gross weight.

Never-exceed speed of 160 m.p.h. is comfortably high in this model of the Cessna range, and the maximum manœuvre speed of 140 m.p.h. is also well above normal cruising. Limit speed for flap operation is 100 m.p.h., and actuation of the central lever is not accompanied by any major trim change.

Circuit Handling

After attempting, without success, to engage the autopilot, or rather pilot aid, which can be linked with the ailerons to keep the aircraft laterally level, or turn it when required via a knob on the instrument panel, we rejoined the circuit at Biggin for some circuits and bumps. On the western threshold of the short runway, there is a formidable wind gradient from the ridge, and the first landing was made with moderate power to the flare-out point, at about 65-70 m.p.h.

On closing the throttle, the 172 dropped smartly on to the runway, and stayed firmly put during a very short ground run. A second approach, power-off, gave a very steep descent path with full flap, again at about 70 m.p.h., and some 1,000 ft./min. sink. Elevator control was adequate for the pronounced flare-out and another three-point touch-down after a very short float. The nosewheel can apparently be held off during landing, but I did not succeed in doing it, although I did not try particularly hard.

The handbook mentions a possible downward pitch when sideslipping with flap, but why anyone should want a steeper descent than that offered is difficult to understand. It might even be more comfortable to use only 30° of flap, except for really short landings, although the additional 10° is extremely useful. No difficulty is presented in over-shooting with full flap, the nose-up trim change being easily countered with one hand.

That, then, is the Cessna 172. Very simple and pleasant to fly; its emphasis on low-speed performance, with a moderate cruising speed; comfortable and quiet; above-average safety. In fact, an aeroplane for the occasional pilot which the veteran will also enjoy. It is hardly surprising that 1,100 were sold in the first year of manufacture.

Technical Data

DIMENSIONS.—Span, 36 ft.; length, 25 ft.; height, 8 ft. 6 in.; wing area, 174 sq. ft.

WEIGHTS.—Empty, 1,290 lb.; fuel, 222 lb.; oil, 15 lb.; pilot and passengers, 630 lb.; baggage, 43 lb.; gross, 2,200 lb.

PERFORMANCE.—Max. speed, 135 m.p.h.; max. cruise, 124 m.p.h.; initial climb, 660 ft./min.; service ceiling, 13,300 ft.; stalling speed, 52 m.p.h.; endurance at max. cruise, 4.2 hr.; max. range, 600 miles; take-off runs, 725 ft.; landing run, 680 ft.

! (*Personal Flying Notes appear on page* 452)

On the ground, the Cessna 172 displays its large slotted flaps in their fully extended position, its clean all-metal airframe, and compact, spring-steel undercarriage legs.

Photographs copyright "The Aeroplane and Astronautics"

Astronautics and Missiles

Techniques Behind Lunik III

ONE was prepared to be surprised by the Russian achievement of photographing the hidden areas of the Moon, but nothing about this remarkable experiment was more surprising than the method employed.

When the U.S.A.F. made their valiant, if unsuccessful, attempts to send Pioneer probes to the Moon and photograph it last year, they simply spun the vehicle and relied on a simple photo-electric device, fitted at 90° to the axis, to scan successive strips of the lunar surface when the probe and the Moon happened to be favourably placed. A similar system is employed in the Atlas-Able Moon-probe, scheduled for launching in late November. The unit receives and focuses light and dark impressions, by means of a mirror, down a tube; an electronic counter then interprets the impressions and converts them, via the storage and transmitting circuits, into appropriately modulated radio signals.

Few would have dreamed that the Russians would use an orthodox camera device and scan the negative!

According to the *Tass* news agency one 35-mm. camera and lenses of 20-cm. and 50-cm. focal length respectively were employed, pictures being taken using different exposures. Pictures from the latter lens would naturally be on a larger scale.

An automatic device controlled the processing of the film after exposure. The resulting negative was then presented to an electronic scanning device which converted light and dark impressions on the negative into coded signals. These data were stored inside the probe and subsequently transmitted to Earth during the daily periods when the transmitters were brought into operation.

The pictures were reproduced as half-tone photographs at the receiving end of the radio link by rebuilding the dots of graduated light intensity from the modulated signals, after the fashion of a TV receiver—but at much reduced speed. The process is perhaps more analogous to the method of facsimile reproduction which has been used for years in the commercial transmission of news pictures by radio.

To orientate Lunik III as it approached the Moon, the Russians appear to have incorporated a Sun-seeker in the rear end of the probe. Presumably a photo-electric device in the front end, adjacent to the camera, was locked on to the Moon's sunlit face. Such devices would enable the probe to obtain the necessary spatial references it required to line up its camera with the lunar surface.

It seems that the actual orientation was carried out by momentum wheels powered by electric motors. Operating power for the camera mechanism, the storage and transmitting equipment, and the auto-stabilizer, were obtained from solar cells and chemical batteries.

The first pictures were apparently secured when Lunik III was about 37,500 miles from the Moon while it was still moving towards the Sun; that is to say, when about 40% of the lunar surface was coming into view. The Russians presumably arranged for the camera to operate when the probe was roughly on a line joining the Sun and the Moon. In this position, the Moon would, of course, have appeared "full," which explains why so much glare exists in the photographs released in Moscow on October 26.

Information supplied by *Tass* gives the length of the 614-lb. Lunik III as 51.18 in. (less aerials), and it is of interest to compare the photographs of Luniks I and III. Lunik I was launched on January 2 and after skirting the Moon passed into orbit around the Sun.

Both pictures show the probes mounted on the same type of handling trolley before launching and, so far as one can judge, there are certain common items of equipment. Evidently scientific research apparatus was embodied in addition to the camera. There is also a dimensional similarity between the hemispherical base of Lunik III and the spherical Lunik I.

The same technique of utilizing components developed for previous vehicles was employed in the dog-carrying Sputnik II. This used a spherical container for its radio equipment having the same diameter as that which served for the entire body of Sputnik I.

From this, it is tempting to deduce that the Russians are reducing development time by using as much as possible of their existing tooling and equipment. This is a philosophy which may well extend to their launching vehicles.

What of the future? Soviet scientists are already talking of the problems they will have to face in obtaining reliable information over interplanetary distances, and there can be little doubt that launchings to Mars and Venus will be attempted at the next favourable conjunctions. A minimum-energy transfer to Mars could be made next autumn, and a similar launching to Venus could follow in January, 1961.

Nearer home, the use of photographic apparatus in close-orbit Earth satellites would appear a possibility for mapping the Earth's changing cloud cover and for pin-pointing storm centres. This could lead to great advances in the science of weather forecasting, and might also be of interest for reconnaissance purposes.—K.W.G.

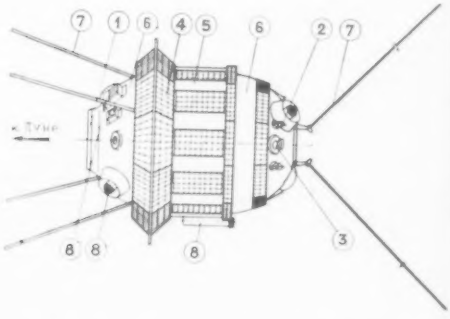
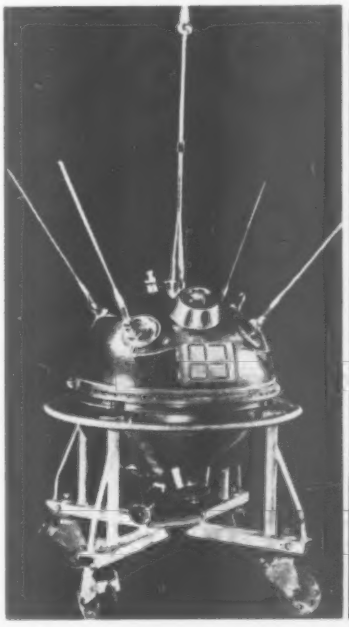
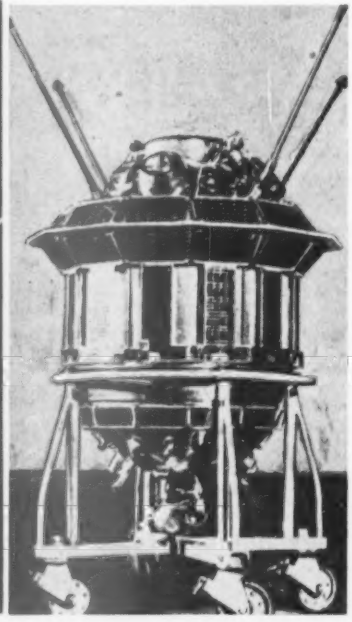


Diagram of Lunik III showing the disposition of equipment: 1, window for camera; 2, motor of the orientation system; 3, solar monitor; 4, solar battery section; 5, shutters of the temperature regulation sytem; 6, "thermo-screens"; 7, aerials; 8, research equipment.





Right, comparison of Lunik I (left) and Lunik III suggests the use of certain common components. Pictures of Lunik II—the probe which hit the moon—have so far not been released.

Interplanetary Communication and Navigation

by Dr. Peter A. Castruccio*

FUTURE travellers in space will be faced with the problem of guiding their flight, and establishing reliable communication channels with their home bases and with other space travellers. Some of the principal problems facing the future space navigator in these fields are: (1) navigational guidance, involving determination of ship position and direction of travel; (2) ship-to-base communications; (3) ship-to-ship communications; (4) anti-collision means; and (5) planetary mapping from a planet-circling space ship.

Guidance Accuracy

Conceptually, space navigation is relatively simple because the position of celestial bodies can be accurately predicted. Therefore, an accurate course can be plotted to the future position of the particular destination, taking into account the various forces acting upon the craft. While this requirement appears simple at first glance, in practice the exactness and accuracy required make it extremely difficult. Such a course requires not only the exact knowledge of the orbit and position of celestial bodies, which must be calculated accurately, but it also requires an equally precise knowledge of the direction of travel and velocity of the spaceship.

The necessary accuracy can be visualized by an example. Assume a voyage to the planet Mars, with a trajectory timed to intercept the orbit of that planet at its nearest distance to the Earth, approximately 36 million miles. An error in launching angle of one minute would result in a positional error of 10,000 miles at the end of the trajectory. Since errors of several minutes exist in the best launching systems under ideal conditions, the difficulty is obvious.

Assuming the trip is performed with an initial speed of 12 miles per second (43,200 m.p.h.), an error of 1% in initial velocity would cause an error at the end of the trajectory of about 400,000 miles. Such errors, although small compared to the distance travelled, necessitate additional fuel consumption at the end of the trajectory to place the ship in the correct final orbit.

Navigation, among other things, involves a knowledge of position and velocity vector. In space these quantities are characterized by three parameters each, or six parameters in all. Navigational information can be obtained by measuring the position of stars or the planets of the Solar System (for navigation within the Solar System). Stellar navigation can be performed by establishing a co-ordinate system with the Sun as its origin and three stars defining three axes drawn from the Sun to these stars.

However, observation of the stars is not sufficient to obtain positional information; because the stars are so far away, for all practical purposes they are points at infinity. The only information that can be gathered from star observations in space is the direction of the radius vector from the origin of the co-ordinate system to the ship, and the ship's direction of travel.

To determine absolute position, the magnitude of the radius vector must be known. This can be done by measuring the apparent diameter of the Sun. If a one second error of arc is assumed in measuring the Sun's apparent angular diameter, and the ship is at a distance from the Sun equal to the Earth's distance (approximately 100 million miles), the resulting error in the magnitude of the radius vector is about 40,000 miles.

Another method of navigation is to observe the planets instead of stars. This yields absolute position with greater geometrical accuracy than star and sun-diameter observations, but requires an accurate knowledge of planet position at any given time, which involves the use of an extremely accurate chronometer. Observations of the planets for navigation within Mars' orbit, with instruments accurate to one second of arc, and a chronometer accurate to a hundredth of a second would mean, in most cases, positional errors of about 1,000 miles.

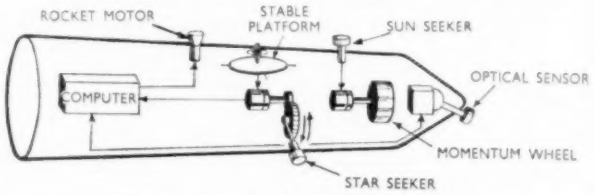
Although both of these methods lend themselves to measurements of the absolute ship position, neither allows for a quick determination of ship velocity. This quantity must be determined from successive observations.

The accuracy with which velocity can be determined is directly proportional to the length of time between observations. This will not constitute too great a drawback in the beginning of space-navigation, when ships will be "slow" and plenty of time will be available for observations. However, as speeds increase and flight times decrease, the need for rapid positional and velocity fixes and trajectory computations will become greater.

* Air Arm Division, Westinghouse Electric Corp., Baltimore, Maryland.

Radar Techniques

Navigational guidance can be obtained with radar techniques. Thus, systems similar to those used in aircraft radio navigation could be established in space. The principal difference between present-day navigation systems and space systems is that Earth-based navigational aids are fixed, while in space they will of necessity move with respect to the Solar System's frame of reference. This complicates the problem because now both the guiding base and guided ship move relative to the point of arrival.



Mid-course celestial navigation system.

Nevertheless, such navigational systems could still be conceived in several forms:— (1) Beams aimed between planets, forming "polygons" of variable sizes; (2) very broad or omnidirectional beams transmitted from planets or satellites can provide an intercept course with a proportional navigation system; and (3) space LORAN.

Of these possibilities, the first is interesting because it would allow the spaceship to operate in much the same fashion as a beam-rider missile. The beam-rider is a convenient guidance system, but has several disadvantages, such as a longer, and therefore uneconomical, flight path. This form of guidance is definitely reserved for the fast spaceships of the future. Also, it would not guide the ship all the way to its destination planet; a terminal phase of guidance would be needed because of the high terminal accelerations required.

For the second possibility, the radiating source would be located at the destination, and the ship could navigate in much the same fashion as a proportional-navigation homing missile. This type of missile automatically follows the shortest straight-line course to the target. In this case, the source pattern would need to be broader than for the previous cases—probably an omnidirectional radiating source.

Navigation would be simple, at least in theory. The particular frequency corresponding to the destination point would be selected, and the automatic mechanism within the ship would do the rest, always maintaining the ship in a "shortest distance" collision course. The source could be located on the planet of arrival, or on a satellite of the planet, either artificial or natural. Because of the rotary motion of all these bodies, several sources would have to be installed on the planet surface.

The third possibility would employ beacons similar to the presently used LORAN (long-range navigation) system, except that LORAN operates in two dimensions, while the space navigation system must operate in three. Thus, at least four omnidirectional transmitting beacons could be set up in known orbits around the Sun. The position of the ship within the solar system would be determined by measuring the differences in the arrival times of pulses issued by the four beacons, which would have to transmit pulses correlated in time similar to the LORAN system.

Range

The fundamental problem of radio-navigation in space is that of radio range. So far as is known today, no obstruction or refracting and diffusing elements exist in space that would distort radio signals. Thus, radio-navigation in space ought to be more accurate and disturbance-free than on the Earth's surface. Furthermore, no line-of-sight problems arise, permitting extensive use of microwaves, with all their advantages.

Range depends on the power used, the degree of beaming, the sensitivity of the receivers, the transmission and reception losses, the amount of intelligence to be transmitted, and the means employed to extract information from the received signals.

OMNIDIRECTIONAL TRANSMISSION.—For omnidirectional transmission and reception, range is a direct function of wavelength and longer wavelengths (low frequencies) are desirable. The choice of frequency will be limited primarily by the size of receiving antenna allowable on the spaceship; an upper convenient size is probably around 4 m. (13 ft.), which sets the frequency at 35 to 40 megacycles (VHF band). At these frequencies, high average powers can be obtained.

The ratio of peak-to-average power obtainable is not as favourable as at the higher frequencies, mainly because effort has not been concentrated in that direction. This situation would at least temporarily favour the use of these frequencies for high-duty cycle applications, such as voice communication.

The range obtainable for omnidirectional transmission and reception can be calculated. Assuming parameters applicable today, it would be about 18 million miles for code communication, or 10.5 million miles for voice communication.

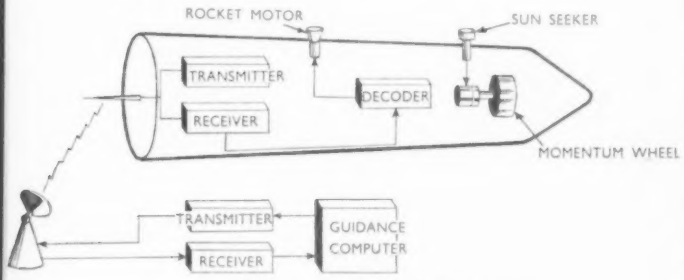
BEAMED TRANSMISSION AND RECEPTION.—Range can be increased further by beaming both the transmitter and the receiver. Limitations to this method are primarily the practical sizes of the receiving and transmitting antennas, and the knowledge that one end of the communications link has of the position of the other end. Thus beaming is desirable in planet-to-planet communications and in ship-to-base communications; it is not as desirable in base-to-ship or ship-to-ship communications.

Means to Increase Range

Range can be increased by: (1) increasing transmitted power; (2) increasing antenna size; (3) improving system performance, i.e., improving the receiver sensitivity and reducing system losses; (4) improving information content of the signal and means to extract signal from noise; and (5) reducing the quantity of information per unit time (increasing the time duration of the transmitted message).

By 1970 an improvement in transmitted power by a factor of 10 can probably be achieved. Power, however, means weight—thus power improvements are more likely to be applicable to base transmitters than to shipborne equipment.

Increases in antenna size are limited by physical considerations and thus may not be universally applicable. Antenna sizes of about 100 m.^{2} are believed to be the upper limit for shipborne systems.



Mid-course radio navigation system.

Much fruitful work can be done on improving receiver sensitivity. Recent developments in travelling-wave tubes, and development efforts towards better receivers point in that direction. By 1970, receivers undoubtedly will have sensitivities at least four times better than present receivers.

In the microwave region "cosmic noise" is considerably lower than the noise generated within the receiver. Since noise is a direct function of the temperature of the receiver, this suggests the possibility that by cooling the receiver internal noise can be reduced. In space, cooling to very low temperatures can be achieved by simply shielding critical receiver elements from the Sun.

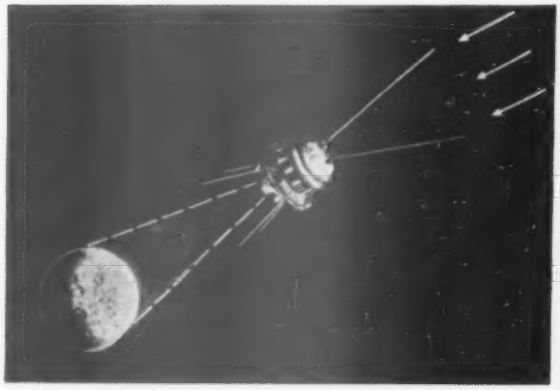


Diagram showing the position of Lunik III when photographing the Moon; arrows indicate the direction of the Sun's radiation. A sun-seeker is said to have helped in the probe's orientation.

Experimental data seems to indicate that "cosmic noise" is equivalent to a temperature of about 30°K. Assuming the receiver is cooled to 30°K, the improvement over a 300°K ambient is 7.5 db.

Improvements in coding and decoding techniques can be anticipated by 1970, amounting to 10 db over present system performance.

Message spread-out in time is a technique that will be particularly adapted to space travel, especially on long flights. With this technique, the range improvement will be proportional to the square root of message duration.

Recapitulating, the improvements over present performance reasonably expectable by 1970 amount to:—Power improvements, 10 db; improved receiver sensitivity, 6 db; cooling, 6 db; coding and decoding improvements, 10 db. This represents a total improvement of 32 db, or a range improvement of 40 times compared with the values previously given. Even further improvements can be expected from the time-spread technique.

Communications

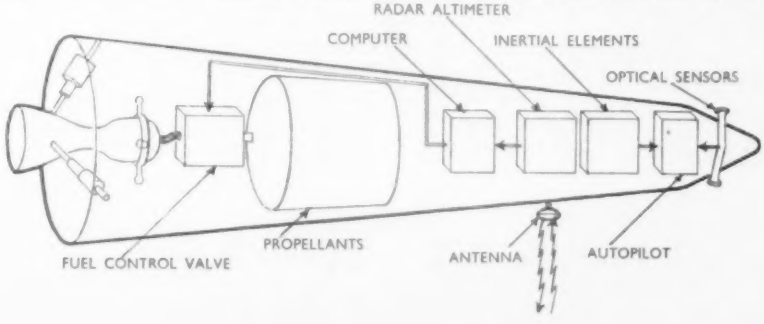
The next problem facing the space traveller is communication. The required communication links are base-to-ship, ship-to-ship, and ship-to-base.

Base-to-ship communications have the advantage that a very powerful station can be set up on the base. Considerably greater power will be required for video communication, such as television signals, than for voice communication.

The base-to-ship range for omnidirectional transmission and reception on voice communication with present-day equipment performance was previously estimated at 10.5 million miles. This is obviously insufficient for interplanetary flight. With improvements expected by 1970, a range of perhaps 400 million miles could be achieved, which is adequate for communication between the near planets (Mars, Venus, Earth).

For code communication, the time-spread technique is usable so that even greater ranges are attainable. Presumably, this technique can be employed on very long trips to the outer planets. Considerable time will be required and the need for rapid communication will not be pressing. The situation can be further improved by beaming.

Beaming the base transmitter is desirable when the ship's position is known; otherwise, scanning techniques must be used.



Terminal guidance system.

which takes more time. A drawback to scanning is that over interplanetary distances, radio transmission time is not negligible; in fact, for transmission to ships located anywhere within the Earth's orbit, it can be as high as 12 minutes.

The round-trip duration—the elapsed time between the transmission and receipt of acknowledgment of the signal (in radar language, the acquisition time of the other end of the link)—can therefore be an appreciable fraction of the scan time. Consequently, the target can easily be missed unless extremely slow scans are used. Once the ship is detected, the beamed transmitting antenna can be oriented in the proper direction. If the target position is totally unknown, the omnidirectional system is more convenient than beaming and scanning.

Ship-to-base communications will suffer from the limitations of power and weight of shipborne equipment, so that ship-to-base range will generally be lower than base-to-ship.

An interesting possibility is offered by the characteristics of acceleration-free space flight. Under these conditions, the ship can eject a collapsible, light-weight, large antenna. This antenna would travel alongside the ship and could be pointed towards the base to achieve long-range communication with limited power.

An interesting possibility for all navigation and communication systems is offered by the fact that the Solar System is nearly "flat"—all planets and other celestial bodies (asteroids, meteorites, etc.) travel in almost coplanar orbits. Thus all travel in the Solar System might be performed within the plane of orbits.

Omnidirectional systems would not be required, except for relatively close-in ranges; for longer travels (such as Earth-to-Mars or farther), the radiated (and received) antenna pattern need not be spherically omnidirectional, but merely omnidirectional in azimuth, with restricted elevation coverage. This would result in considerably increased ranges over the omnidirectional values previously stated; even the relatively broad vertical beaming of 30° in transmission would increase omnidirectional ranges by a factor of about 2.5.

Although the probability of encountering dangerous meteorites now appears to be extremely low, as is the probability of colliding with another spaceship, it is interesting to investigate what could be done to avoid at least the larger meteorites. An often proposed solution is an anti-collision radar. But the radar problem is difficult because of two factors: (1) the small size of the meteorites, and (2) the large frequency shift caused by Doppler effect.

An effective anti-meteorite radar must be able to protect the ship against fairly small objects. A 1-lb. metallic-core meteorite, travelling at speeds relative to the ship or tens of miles per second, could cause considerable damage and even destruction of the ship. Such a meteorite has a geometrical cross-sectional area of approximately a tenth of a square foot. If the meteorite is irregular and rock coated, or if it is metallic and approximately spherical, its radar cross-section is of the same order of magnitude as its geometrical cross-section.

For a meteorite travelling head-on towards the ship at relative speeds of 40 m.p.s., radar equipment foreseeable in the next 20 years would only have sufficient range to allow about two seconds to detect the meteorite, plot its course, determine that it is a collision course, compute the ship's manœuvre to evade the meteorite, and actually evade it. For meteorites travelling at relative speeds of 20 m.p.s., the time to do all this is increased to four or five seconds.

Only small targets of about a tenth of a square foot have been considered. Against larger targets the situation is only slightly better. Radar range increases as the fourth root of target size, so that even if target size increases by a factor of 100, range would only increase a little over three times. This increased range would give a warning time of about seven to eight seconds for head-on meteorites—still not enough for all the action that must be taken.

Satellite Navigational Aid

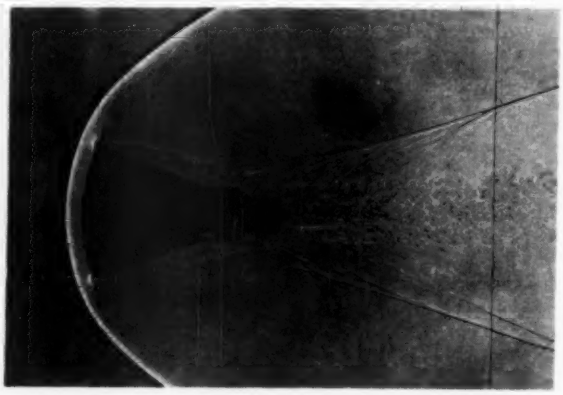
A SATELLITE navigational system, which could play an important rôle in the launching accuracy of the seaborne Polaris missile, has been under development for some time by the U.S. Navy. This is the Advanced Research Projects Agency's Transit satellite, which it is hoped will be developed by 1961.

The first attempt to orbit a 265-lb. prototype Transit vehicle failed on September 16, when the third stage of the Thor-Able launching vehicle failed to ignite. Preparations are now being made to launch a second vehicle, but the project is apparently being hampered by lack of funds and the next attempt is unlikely to be made before February or March next year. ARPA's anticipated spending on the project amounts to no more than about $20 million over the next two years, which leaves little room for vehicle-launching failures.

Object of the Transit programme is to provide four 50-lb. satellites in orbit at about 400 miles with an estimated lifetime of four to five years. Once the vehicles are circling the Earth, a ground station will fix their positions for each successive 24-hr. period; this information will then be transmitted to the satellites and tape-stored.

To obtain a precise "fix" of its position at sea, a ship will be able to obtain data from the nearest satellite using special equipment without the need for interrogation. It will also be possible for the ship's equipment to measure the Doppler shift of the satellite's signals, which will determine the precise distance between ship and satellite. The combined data will provide an accurate "fix" of the ship's position, perhaps better than two-tenths of a mile.

Although the project is seen primarily as an adjunct to the Polaris system (e.g., to check gyro-drift in the seaborne inertial navigator), the Transit system is equally applicable to the air-launched ballistic missile. If the high promise of the system is fulfilled in tests, it may be expected to secure more financial support.



Heavy bow shock wave characterizes this shadowgraph of a model of the Mercury space-capsule launched at Mach 3.0 by a high-speed gun at NASA's Ames Research Centre. Optical distortion causes the apparent rim round the model's forward face.

Saturn and Nova

LATEST news from the National Aeronautics and Space Administration is that Dr. Wernher von Braun, recently transferred to NASA from the Army Ballistic Missile Agency to continue his work on the Saturn space-booster, will also be given the Nova project.

Dr. von Braun said last week that the eight-engine Saturn (total initial thrust about 1.5 million lb.) could send a 30-ton satellite into a 300-mile orbit or launch a man on a flight around the Moon. He wants Congress to approve the spending of £85,700,000 next year on this project, £35,700,000 more than the Defense Department has recommended. The original estimate was that Saturn would be test-fired in 1961.

Nova, the even bigger booster which will use a cluster of single-chamber 1.5-million-lb. thrust engines, is being presented as the rocket that could land men on the Moon before 1970. NASA announced recently that it would take the Rocketdyne Division of North American Aviation four to five years to complete development of the engine, and the construction of a multi-stage vehicle using these engines (a cluster of four or possibly six) is scheduled to take another two or three years.

When he visited the Rocketdyne Division recently, Mr. Glennan, the NASA administrator, was reported to have been well pleased with progress with the massive single-chamber engine, the mock-up of which is said to require a two-storey platform for its inspection. The present contract awarded to North American last January amounts to £36,430,000—a mere drop in the ocean in terms of the cost of the total Nova vehicle.

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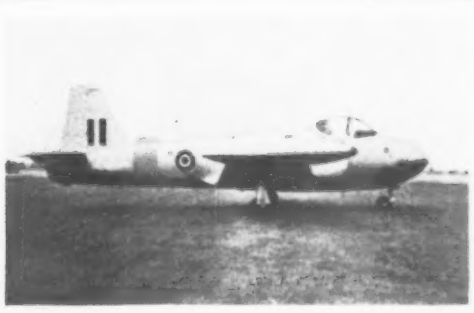

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General Aviation News

D.H. REORGANIZATION. — Some rearrangement and changes in the technical executive of de Havilland Propellers, Ltd., is to be announced shortly. This we understand is principally in connection with the company's guided weapons activities.

LUNIK IMPACT.—Two British astronomers, Dr. H. P. Wilkins and Mr. Patrick Moore, have reported in *Nature* that they may have seen Lunik II hit the Moon on September 13. Observing independently, both report seeing a pinpoint of light and Wilkins a dark ring "just as though dust has been disturbed" immediately afterwards, in the region of Schneckenberg. In both cases, observation agrees with the revised impact time subsequently announced in Moscow of 21 hr. 02 min. 23 sec. U.T.

SATELLITE INSTRUMENT. — A satellite instrument of a type expected to be launched for Britain by the American Scout rocket in 1961 was exhibited at Imperial College on October 22. Designed by Dr. H. Elliot, the instrument weighs 2 lb. and is for cosmic ray studies.

NEW RESEARCH AIRCRAFT.—The slim-delta research aircraft under construction by Handley Page for low-speed flight trials of a supersonic-transport configuration is named the H.P.115. It is powered by one Bristol Siddeley Viper turbo-jet. First information about this project was given in our issue of September 18.

SPACE "BALLOON".—A two-stage rocket fired from Wallops Island on October 29 launched a 100-ft. diameter inflatable sphere at a height of 220 miles; the sphere's skin, 1/20th in. thick, was of aluminium-coated Mylar plastic. It remained aloft for about half an hour. NASA hope to send similar spheres into orbit for use as "reflectors" in radio-communication experiments.

ROCKETS "DOWN-UNDER".—The Australian Academy of Science has drawn up a two-year programme of space research involving rockets and balloons. This will include research into the circulation of the atmosphere, electrical properties of the upper air, meteor dust, cosmic rays, and the emission of light in the upper atmosphere.

CF-100 MAINTENANCE.—Because of the limitations of Renfrew Airport, the overhaul and repair of R.C.A.F. No. 1 Air Division CF-100s is to be transferred to Prestwick. Both R.C.A.F. CF-100s and Sabres in Europe are overhauled by Scottish Aviation, but the work on Sabres will remain at Renfrew.

EJECTION CLUB. — The Martin-Baker Aircraft Co. has formed a club for all who have saved their lives in an emergency with the company's ejection seats. The club headquarters will be at the Martin-Baker factory at Higher Denham, nr. Uxbridge, Middlesex, and there are more than 300 prospective members since the first successful emergency ejection some 10 years ago. All these are invited to write to the company for an application form. They will then be presented with a dark blue club tie.

C.A.S. VISIT.—Marshal of the R.A.F. Sir Dermot Boyle is visiting the United States and Canada at the invitation of the U.S.A.F. and R.C.A.F. At present in America, the C.A.S. is to visit the Pentagon, Air Defence Headquarters, the U.S. Air Academy, Colorado Springs, and Edwards A.F.B. Going to Canada on November 12, he will meet the Canadian Minister of Defence.

AUSTRALIAN MUSTANGS.—The last of the Mustangs in the R.A.A.F. have been withdrawn from service. No. 24 (City of Adelaide) Squadron, now flying Winjells, was the last unit to operate it.

CANADIAN F-104s.—The R.C.A.F. designation for its future Lockheed F-104 Starfighter aircraft to be built under licence by Canadair is the CF-111. Compared with the earlier marks of F-104, the primary airframe structure of the CF-111 is to be strengthened to increase airframe life at low altitude.

RUSSIAN RECORDS.—More Soviet records were recently homologated by the F.A.I. for helicopter achievements. The massive Mi-6, powered by two 4,635-h.p. Soloviev TB-2BM gas-turbines, was flown by Sergei Brovtsev and Pavel Chichov to a height of 20,800 ft. with a payload of 11,023 lb. on April 16, 1959, from Zakharkovo airfield; and to 18,536 ft. carrying 22,046 lb., flown by Raphael Kaprelian and Nicholai Lechin, on the same date. On May 6, a Kamov Ka-15, powered by a 256-b.h.p. AI-14V engine, was flown by V. Vinitskii on a new 500-km. closed-circuit record for its class of 105.9 m.p.h., from Mikhailovakaia-Iljinsky airfield, Moscow.

CRASH CAUSE.—Finding of the C.A.B. inquiry into the accident to a Capital Airlines Viscount last May is that structural failure was caused by violent turbulence in a thunderstorm. There was no evidence of mechanical failure or other cause, but the failure of the air line's flight despatchers to pass on important weather data may have been a factor.

BENSEN HELICOPTER.—Having started with a rotor kite, and modified this into a gyroplane, Igos Bensen has now produced a helicopter on similar lines, for sale at about £2,500. A co-axial design, the Bensen Little Zipster runs on ordinary motor spirit, and is claimed to have operating costs of less than £2 per hour.

Commercial Aviation Affairs

COMETS TO AUSTRALIA. — On November 1 B.O.A.C. introduced Comet 4s on the U.K.-Australia route, cutting nearly 14 hours off the previous schedules for the 12,000 miles. On the same day the Corporation resumed services (suspended in April, 1955) to Israel, with twice-weekly Britannia flights to Tel Aviv and Teheran.

SILVER CITY MOVE.—As from November 18, Silver City will transfer its cross-Channel ferry operational base from Eastleigh, Southampton, to Hurn, Bournemouth, because of the unsuitability of the former for winter services. Silver City operates daily services to Cherbourg and Jersey during the winter and to Deauville in the summer. The administration will, for the time being, remain at Eastleigh.

QANTAS CIRCUIT.—On October 27 Qantas started its delayed two-way round-the-World turbojet services when a 707 left Sydney to fly over the Middle East route to London, where it connected with a 707 leaving for Sydney via North America and the Pacific.

DC-8S FOR C.P.A.L. . . .—Canadian Pacific Airlines have ordered four Douglas DC-8s powered with Rolls-Royce Conway R.Co. 15 turbojets for delivery early in 1961 and have taken out an option on five more. This developed version of the DC-8 will have a gross weight of 315,000 lb. Conway-engined DC-8s are shortly due to be delivered to the other major Canadian operator, Trans-Canada Air Lines.

. . . AND FOR IBERIA.—Three Douglas DC-8s have also been ordered by Spain's national airline, Iberia, for services to Latin America and across the North Atlantic. They will be powered by Pratt & Whitney JT3D-1 turbofans.

STOCKHOLM'S AIRPORT.—If the good weather continues the 10,825-ft. runway, taxi-tracks and apron at Stockholm's new Arlanda airport should be completed before the end of this year. During a little less than a year's operations 53 million cubic feet of rock and earth have been removed. The first-stage buildings will also be ready for use in December.

INTERFLUG CLARIFIED.—Difficulties experienced by the East German Deutsche Lufthansa in various countries where the West German Deutsche Lufthansa also operates, led to the setting up of Interflug as an independent company with limited liability. Both companies are state-owned.

FERRY APPLICATION. — B.K.S. Air Transport has applied to the A.T.A.C. for permission to operate a vehicle ferry between Liverpool and Dublin next summer. Using Bristol 170/32s, the scheduled time would be about 50 min. and the one-way fare for a small car, will be £12 10s.

EAST MIDLANDS AIRPORT.—Derby Town Council has approved "as a matter of policy" a proposal to develop the disused R.A.F. airfield at Castle Donington as an East Midlands Airport. This co-operative project, involving Derby, Nottingham and Leicester City Councils, was described at the 1958 Aerodrome Owners Association conference (see THE AEROPLANE of October 3, 1958, p. 520).

EUROPEAN HERCULES? — Lockheed Aircraft Corpn. hopes to negotiate licensing agreements for the manufacture in Europe of its C-130 Hercules turboprop transport. To this end its Georgia Division is establishing a European base in Paris under the direction of Mr. R. T. Stoessel, who until now has been manager of Hercules commercial sales.

HELITAXIS.—A metered helicopter taxi service between the St. Louis (Mo.) Airport and two downtown hotels has been inaugurated by Remmert-Warner Inc. Similar services are planned for Toledo, Ohio and Pompano Beach, Fla.

HIGH LOAD FACTORS.—The four Viscount 810s flying with VASP of Brazil have been operating at very high passenger load factors. Averages have been as much as 80-100% on some routes, notably that from Salvador to Rio (99%) and between Sao Paulo and Brasilia, the new capital city (81% in each direction).

FREIGHT GROWTH PROSPECT.—Average freight rates within the U.S. will be reduced from 18 cents to 13-14 cents per ton-mile when the Canadair CL-44D-4 is introduced in 1961, according to Mr. Robert W. Prescott, president of The Flying Tiger Line. Some commodity rates may go as low as 10 cents. By 1965, reductions of this nature should boost air freight throughout the World to 7 to 10 times its present level, according to a Flying Tiger analysis.

ONE MILLION UP.—The millionth passenger in a Boeing 707 on scheduled service was carried during the first week of October. Since October 26, 1958, Boeing 707s had then totalled 64,000 flying hours.

TYNE FLIGHT HOURS.—The Rolls-Royce Tyne has now accumulated over 5,000 hours in flight. The figure of 1,500 hours quoted on page 344 of our issue for October 16 refers to the Tyne-Ambassador which is engaged on intensive flying trials and was inadvertently given as the total.

COLLABORATION. — Max Holste and Nord Aviation have signed an agreement covering their joint development of the MH 260 Super Broussard twin turboprop transport.

NEW IN N.Z.—Bay of Plenty Airways, a new New Zealand company, has started a tri-weekly service between Tauranga, Rotorua and Wellington.

News About People

NEW PRESIDENT.—Wg. Cdr. E. W. Anderson, O.B.E., D.F.C., A.F.C., F.I.N., F.R.Met.S., has been elected President of the Institute of Navigation. He is a founder member of the Institute and has just completed two years as vice-president. Wg. Cdr. Anderson is project manager of Sperry's Bracknell Division.

BLACKBURN CHANGES.—Mr. Eric Turner, chairman and managing director of Blackburn Group, Ltd., is resigning these posts to join B.S.A. on January 1; he will remain on the Blackburn board. Mr. A. F. Jopling, A.C.A., becomes chairman, and Mr. N. E. Rowe and Capt. E. Lewin become joint managing directors.

AGARD DELEGATES. — New Canadian delegates to the NATO Advisory Group for Aeronautical Research and Development (AGARD) will be Mr. John L. Orr, Director of Engineering Research, Defense Research Board, and Mr. Frank R. Thurston, Director of the National Aeronautical Establishment. They succeed Dr. John J. Green and Dr. Duncan C. Macphail. For the first time, Greece has two national delegates to AGARD. Dr. Michael Anastassiades joins Colonel N. Papadimitriou who has represented Greece since 1957.

DOWTY APPOINTMENTS.—Colonel C. W. King has resigned his position as works director of Rotol Ltd. and British Messier Ltd. He was formerly general works manager of Rotol Ltd. Mr. A. E. Atkins, at present production controller of Dowty Equipment, Ltd., has now been appointed general works manager.

RADIO AWARDS. — The Council of the British Institution of Radio Engineers has announced the awards which are to be presented on December 2 for outstanding papers published in the Institution's Journal during 1958. The senior award, the Clerk Maxwell Premium, goes to Mr. C. Powell and Mr. D. A. Hendley (Decca Navigator Co., Ltd.) for the paper "Dectra: A Long Range Radio Navigation Aid." Other awards include the Heinrich Hertz Premium to Mr. K. Foster (Cossor Radar and Electronics, Ltd.).

WESTLAND VISITORS.—The Minister for the Burmese State of Kayah, The Hon. Sao Wunna recently visited Westland Aircraft Ltd. Seen here are, left to right: Mr. H. J. Penrose, Westland sales manager; Mr. Sao Khun Sam; The Hon. Sao Wunna; Mr. D. C. Collins, deputy managing director; Mr. Saw Ohn Tin; and Mr. W. H. Sear, chief test pilot.

A B.O.A.C. RETIREMENT. — Mr. A. C. "Wickham" Hughes, M.B.E., who joined Imperial Airways in 1934 as a salesman, retired from his position as B.O.A.C.'s Agency and Interline Manager on September 30. He is succeeded by Mr. Kenneth Everall, also a former Imperial Airways employee.

CONVAIR SALES.—Harvey C. Tafe, Convair assistant to the vice-president for military sales, has been appointed director of foreign military sales. Charles W. Tuck, the company's military relations representatives in San Diego, has been appointed European military sales representative, with headquarters in Geneva.

MR. ADOLF STRANGE-HANSEN. A very well-known personality in European private aviation circles, Mr. Adolf Strange-Hansen, Copenhagen, was killed recently when his KZ III collided with a mountain-side during a rally in Austria. Mr. Strange-Hansen, who was 70, learned to fly shortly after the War, and took part in a great number of rallies each year. He had many friends in England and was the winner of the competition in connection with the Jersey Rally in May this year.

MR. F. W. LEAKE.—We regret to record the death of Mr. F. W. Leake, M.I.E.E., on October 14. Mr. Leake was sales manager (works administration) of British Insulated Callender's Cables, Ltd.

Book Review

AIR ACES OF THE 1914-1918 WAR. Edited by Bruce Robertson. 212 pp., 8¼ in. by 11¼ in. Published by Harleyford Publications, Ltd. Price 45s.

THE title of this book rather put me off for I dislike the word "ace" being applied to great fighter pilots. It is a word beloved by the reporter and abhorred by the R.A.F., although I have known it used as a nickname for a certain officer of more than Prunish mental calibre.

Be that as it may, there can be no doubt that the editor of this book and the authors of the various sections have put in an enormous amount of historical research, and have collected a very great deal of data of very considerable interest to an old deadbeat like "Polygon," who was privileged to have taken part in the air fighting on the Western Front from early 1917 up to March, 1918, and who knew a number of the great fighter pilots of that somewhat exciting era. Whether the book will prove of equal interest to the public of today is a matter on which I am not qualified to judge. But I suppose there still are many people interested.

Some very interesting facts emerge from a study of the book, in particular the figures given for victories claimed by the so-called "aces." I suppose that the total losses of aircraft on either side are now known reasonably accurately to the historian and, of course, the scores of the "aces" may have little or no relation to the total figures. Yet it is indeed remarkable to note that, according to this book, the leading Allied fighter pilots shot down no less than 8,700 aircraft, compared with 5,000 shot down by the great pilots of Germany and Austro-Hungary.

Standards of fighter performance and armament during the bitter air fighting of 1917-18 were approximately equal on either side and this makes the great discrepancy in the number of victories claimed even more remarkable, for the Allies never had anything in the way of fighters which could sweep the enemy out of the sky as did the Fokker monoplane. One is driven to the conclusion that the figures of victories attributed to certain Allied fighter pilots were not altogether accurate, although this, of course, is not the fault of the editor or his authors, who have recorded the facts given to them by historical archives, etc.

I would never query the claims made by fighters such as Ball or Micky Mannock, the latter not only a dedicated killer but also an inspired leader. But perhaps it was only too easy to come back from a lone patrol in the early morning and tell the adjutant that another E.A. had been shot down.

Also, I have always marvelled at the ability of certain fighter pilots who, engaged in a bitter dog-fight at 17,000 ft., could be so certain that the Hun who appeared in their sights for a short burst was not only destroyed but also crashed to the ground. Perhaps such pilots had a third eye equipped with a telescope. On the other hand, I would place considerable credence on the claims of the German fighter pilots, for it was no good claiming a victory when fighting over your own country unless one could get verification from people on the ground where the enemy had crashed.

When collecting and collating such a vast mass of material about events of over 40 years ago it is inevitable that some mistakes and errors creep in. For example, the late Air Marshal Sir Arthur Conyngham is shown in the index as "A. Cunningham" and as "Major A. Cuningham" on page 42. Captain Kinkead is shown as belonging to 201 Squadron, although he fought for many months with No. 1 Naval Squadron. Incidentally, that squadron took all their Triplanes back to Dover to re-equip with Bentley Camels and then flew out to Teteghem as a squadron. The squadron did not re-equip in bits and pieces as described on page 41.

But such minor errors are negligible and I do think that the editor has made a very fair selection of the great fighters he has chosen for their brief biographies. From a personal point of view, I would have cut out one and put in his place S. M. Kinkead, a pilot of great ability and a man of outstanding character. You can see his portrait in the R.A.F. Club.

I feel sure that the editor and his collaborators have taken as much care with the foreign sections of the book as they have with the English section. It is difficult for me to judge, but I can confirm the opinion given in the book of Udet. A most likeable man. I met Guymener and Willy Coppens, but never met René Fonck. According to a little play on television, he was a lay brother in a Trappist monastery in the days of the Hitler War and rescued one of our pilots who had baled out—an interesting story if true.

I think all old fighter boys of the Kaiser War who are alive today will like this book. And also it is of considerable interest to all students of air warfare.—"POLYGON."

Gliding Notes

by Dr. A. E. Slater

LAST year the annual OSTIV Prize was awarded to Dr. Joachim P. Kuettner, a professional meteorologist who has specialized in wave soaring, starting with a climb to 22,300 ft. in the "Moazagotl" wave in Silesia in September, 1937, and reaching 43,000 ft. in the Bishop wave in California five years ago. He is convinced that, after climbing up to a Jet Stream over Bishop, one should be able to go more than 1,000 km. downwind by using a series of waves in the jet; he tried it himself and exceeded 600 km.

Now it is time for candidates for the 1960 OSTIV Prize to send in their names to the president, Mr. L. A. de Lange, at Kanaalweg 3, The Hague, Holland, by early January. The prize is awarded to "the person who has made the most important technical or scientific advancement in soaring flight," and nominations should mention recent contributions to soaring flight especially, though any earlier work should be mentioned and a short biography should be included.

* * *

THIS year's Polish National Championships were held at Leszno, like last year's Internationals, and the aggregate distance covered in cross-country flying was 62,235 miles, which is a little over 100,000 km. Austria, Czechoslovakia, Hungary and Yugoslavia sent one visiting pilot each.

Poles took the first five places, their total scores being: J. Popiel, 9,008; J. Pieczewski, 8,900; Z. Kirakowski, 8,783; J. Adamek, 8,771; A. Witek, 8,655. Witek won in the Standard Class at last year's World Championships.

Before the national meeting, the Leszno centre had a remarkably good spring, as if in celebration of its having become Poland's Central Soaring School on January 1. Between April 8 and June 7, cross-countries flown totalled 23,270 miles.

During an expedition to the Tatra mountains, new national records for altitude were set up, no doubt in waves. Mr. Niechwiejczyk exceeded 29,000 ft., and Miss Antoszewska exceeded 28,000 ft. for a women's record.

* * *

BETWEEN May 17 and October 4 there were 47 cross-countries from the Derbyshire and Lancashire Gliding Club, according to *Camphill News*, which concludes the list with the words: "To be continued." They add up to 3,908 miles and include two solo flights of over 300 km.: one by Stan Armstrong (Olympia) for his "Goal Diamond" in May, and one by Brian Jefferson (Skylark 3) for Gold "C" distance on that famous cross-country day, July 19, while Walter Neumark (Skylark 2) fell short by only 4 miles on August 30, which was the club's best day with seven flights totalling 943 miles.

Michael Kaye's T-42, which he calls "Odin," distinguished itself on both these notable days. On July 19, with Mr. Birkett as passenger, he made 134 miles to the Coventry Club at Baginton and back again. Across the light west wind he took 4 hr. 52 min., using 28 thermals and spending an average of 6 minutes in each one with an average gain of just over 1,000 ft., while the high-speed glides between thermals averaged 4½ min. each.

On August 30, in a light north-easterly, with Ernest Martin as passenger, he declared for Exeter via Cranfield, the idea being to start across wind for the Chilterns and then use the good lift to be expected along the chalk downs. The declared distance was 245 miles, only 9 miles short of the National and U.K. record set up by Lorne Welch and Frank Irving in May, 1955, with a flight from Lasham to Louvain in another T-42.

They were away at noon, B.S.T., with a high overcast chasing them. Cranfield, when they got near it, was under a large spread of strato-cumulus, so they turned at (and photographed) a place called Salvey Forest instead. The highest point was 8,400 ft. inside cloud at Oxford, so evidently they had no need to follow the Chilterns after all. At the two lowest points they were saved at 1,900 ft. by a thermal from a runway at Silverstone, and again at 1,500 ft. by one which was loosed off apparently by pylons at Frome.

At 17.23 they landed, after going 229 miles, a bit short of their goal, at Dunkeswell, the Taunton Vale Club's site, to which C. W. Bentson had flown from Dunstable and Godfrey Harwood from Lasham on the same day. This is so far the longest two-seater flight to start and finish in Great Britain.

Other inter-club flights from Camphill this year were: three to the Lakes Club at Tebay, two to the Yorkshire at Sutton Bank, and one each to the Midland, Blackpool, Cambridge (112 miles) and Bristol (115 miles); all were goal flights.

Personal Flying Notes . . . .

Excessive official zeal, plus inflexible Cabinet rules, appear to have been the cause of the unfortunate grounding order to the Reading Flying Club at Woodley, when Prince Philip flew the Turbulent at White Waltham on October 24. Three days beforehand, R.A.F. Flying Training Command put out a notice that all aircraft within a 10-mile radius of White Waltham had to remain on the ground or above 2,500 ft. for three hours on the Saturday morning.

Interpreted literally, this, of course, would have stopped all activity at London Airport. What actually happened was that nobody was allowed to fly at White Waltham and Woodley during the specified time. Government rules prohibit other aircraft from approaching anywhere near the Duke of Edinburgh when he is flying, and on routine Royal cross-country trips, this object is achieved by the establishment of a temporary Purple Airway.

As Woodley is some six miles to the West of White Waltham, no prohibition on flying by the Reading club, other than to the east, should have been necessary. Prince Philip knew nothing of the restriction which was imposed, and he was " very upset " to hear about it. After all, the roads are not cleared of other traffic when members of the Royal Family are motoring, although an accident in that medium is much more likely.

Similar commonsense is necessary for air traffic rules during Royal flights. The value of the Duke's patronage to personal flying is so great that he must not be discouraged from exercising his enthusiasm because he finds that such occasions bring other amateur air activities to a standstill.

• • •

France has the most active private flying movement in Europe, and with more than 3,000 light aircraft is second only to the United States throughout the World. Eighteen countries, including Great Britain, build French light designs under licence, and a healthy national industry has been established, having produced 2,162 civil light aeroplanes and 1,261 gliders between the Liberation and the end of 1958.

This was achieved despite the industrial disorganization following the Occupation and subsequent battle for France. One of the first moves of the free French Government was the establishment of 450 aero clubs, with financial assistance, and the procurement of suitable equipment for training amateur pilots.

Some 700 Stampe S.V.4 aerobatic biplanes were ordered from S.N.C.A.N. (now Nord Aviation), and the same company also produced 380 Nord 1200 Norécrin 3-4-seat monoplanes for touring. Another touring type was the 4-5-seat S.E.C.A.N. SUC 10 Courlis, 135 of which were built.

Amateur constructors and several smaller aircraft companies added their output to the overall flow, but the French sporting flying movement then suffered from a lack of planning for the next stage of operations, and from a shortage of suitable ground facilities. The result was the discontinuation of many aircraft types, including several in the prototype stage, and the standardization, after a Government competition, on two light aircraft designs for the clubs.

These were the two-seat S.I.P.A. 901 and N.C.853, of which 100 each were ordered for issue to the aero clubs. As the clubs then had to be content with the aircraft donated by the Government, the limited market caused the major constructors to discontinue production of sporting and touring types. Under the normal attrition of club flying, the existing fleet progressively dwindled, and no provision was made for replacements.

The next stage was the re-emergence on a large scale of the amateur constructor, and the marketing of blueprints for such types as the Jodel and the Emeraude. Several small companies were also formed to build these designs under licence, and succeeded with such effect that to date, some 600 Jodel models and about 400 Emeraudes are in operation, as well as many other types in smaller numbers.

Government aid at this stage was in the form of construction premiums to encourage orders from private operators and aero clubs. The small companies were usually sited in the provinces, away from the major cities and expensive labour costs. Sales expansion was stimulated by competition, and efficient customer relations organization, with improved documentation, service bulletins, after-sales service, and the establishment of a used-aircraft department, and so on.

The growth of these small companies stimulated interest in associated equipment, and the production of specialized items such as airscrews and radio and navigational aids. Engine demand was satisfied by the American Continental and Lycoming range of powerplants, in the 90-100 b.h.p. bracket for two-seater aircraft, and 150-200 b.h.p. range for the four/five-seaters.

ROYAL INTEREST.—Following Prince Philip's recent flight in a Turbulent at White Waltham, he was shown the Tipsy Nipper by Avions Fairey test pilot Bernard Neefs. This Nipper is the first to have a dual ignition HEPU engine.

Equivalent French units are now being developed to replace these imported engines. The 90-100 b.h.p. range is being covered by the Potez 4E flat-four unit, and the Chabay engine, while other Potez motors cater for up to 260 b.h.p.

More advanced aircraft designs, including the Jodel DR.100 Ambassadeur, the Jodel D.140 Mousquetaire, and the Wassmer Super IV are now in production, and French interest is now turning to the wide-open executive market. An official competition has also been organized for a two-seat 90 b.h.p. replacement aircraft for the clubs. Five prototypes were selected for evaluation from preliminary designs, and will soon reach the flight-test stage to be selected for production.

There are many lessons from French personal flying experience which can be usefully applied in this country. One is that Government assistance, although extremely useful, is less important than amateur enthusiasm. The second is that this enthusiasm can only expand when Government encouragement replaces universal restriction. It is significant, too, that since a flourishing French industry has been built up, import duty on foreign aircraft has been removed.

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For our latest club round-up, we are varying the formula slightly by itemizing activities at individual airfields.

● BIGGIN HILL was perhaps slightly quieter than usual on Saturday, October 31. This was the morning after the Surrey and Kent Flying Club's annual dinner and dance. It was as well attended as ever, and marked the end of a particularly fine flying summer. Flying hours for September totalled 390. This was good considering that it was completed mainly on five aircraft out of the fleet of nine, through several minor accidents. A recent addition was Chipmunk G-APTS, which has 10-channel VHF and 24-gal. total tankage, and is to be fitted with an MF range receiver. Solo flying in the Chipmunks is £5 an hour.

● AT EXETER, the Aero Club has been acquired by Harper Engineering and Electronics, Ltd. No change is envisaged in its operation. From October, 1958, to September, 1959, 3,400 hours were flown. This far surpasses all previous club achievements. Night flying is undertaken on one or two evenings each week, with a regular cross-country run to Hurn.

● A slightly sad note from LYMPNE, where skyways have announced the cessation of all landing fee and other cost concessions with effect from January 1, 1960. The rates from that date will be in accordance with those of the A.O.A.

● FROM THRUXTON, the Wiltshire School of Flying reports that 3,515.40 hr. were flown to the end of September for the year. This compared with 3,831 hr. for the similar period last year. The drop was due to the foggy weather in the early part of 1959. Jackaroo operation has proved very satisfactory, three out of the six aircraft coming up to their Check III (375 hr.) fairly early in the year. Their maintenance has been good enough for the A.R.B. to agree to an increase in the Check III cycle from 375 to 450 hours. The 20th Jackaroo was recently delivered to Miss Scott, one of the club members. The School no longer operates Austers and is disposing of its large spares stocks at less than list prices. It is also prepared to convert club Tiger Moths to Jackaroos during the winter months at reduced rates of £650, including a new C. of A.

Correspondence

Those Invidious Comparisons

AS B.O.A.C. have come back empty-handed from the International Air Transport Association's conference, it is interesting to compare them with other international airlines.

The enclosed table, which has been taken from published membership information of IATA, compares seven airlines of a similar size. The figures are self-explanatory with, perhaps, the exception of the number of aircraft. Without going into detail, I can say that the variations are such that numbers are directly comparable.

The conclusion to be drawn from these figures is that British Overseas Airways Corporation are exceptionally over-staffed. These conditions have existed for many years and are getting worse. Can the country afford such an expensive luxury?

Mill Hill, N.W.7. R. E. MILLS.

Airline	Aircraft	Passengers Carried	Employees	Route Mileage
B.O.A.C.	61	465,300	19,035	76,894
E.A.L.	228	8,065,000	16,000	18,352
Air France	135	2,517,000	20,579	187,650
American Airlines ..	192	7,792,000	21,461	14,938
P.A.A.	132	2,899,000	21,370	69,921
T.W.A.	199	4,723,000	19,200	50,000
United Airlines ..	198	7,276,000	20,000	14,000

[Our correspondent is not comparing like with like except, perhaps, in the cases of B.O.A.C. and Pan American. Furthermore, his table does not include capacity ton-miles produced—the figure which shows the amount of work actually done. Divide this by the number of employees and you have some sort of yardstick—though an imperfect one, except when comparing airlines which are doing similar work. B.O.A.C. does not come out well on this basis, but not so badly as our correspondent's table would suggest.—ED.]

Jobs for the VTOL-craft

HAVING been struck, both metaphorically and literally by the cloud of dust raised by the jet efflux of Short's VTOL aircraft, it seems that the uses of this machine should not be limited to transportation, but could be adapted to other purposes. Some of the following suggestions might be worthy of consideration:—

1. Fog dispersal over runways, roads, etc. By flying up and down a runway at a convenient height a little above the transition between fog and clear air, the aircraft would clear a passage down to the ground. The same principle could be used to prevent frost damage.

2. More effective cloud seeding to initiate rain or clear skies, by blowing silver iodide crystals into the atmosphere, instead of merely dropping them into the natural air currents.

3. Controlling fires in open country. The air blast might either blow the fire out, or prevent its spread by countering the action of the wind.

4. Removing surface water and drying out sports grounds. ("No groundsman can possibly afford to be without one.")

5. Spraying heavy crops, trees, etc.

Although some suggestions given would probably prove impracticable, thought along these lines might well be worth while.

Wisborough Green, Sussex. R. S. OSMASTON.

The Worthy Tiger Moth

YOUR remarks under Personal Flying (Oct. 23) relating to the Tiger Moth would seem to be unduly harsh. From the point of view of handling, the "manipulation of these curious contraptions of wire and canvas" can hardly be described as a waste of time when it managed to provide initial training for so many pilots in World War II and enabled them subsequently to convert to aeroplanes which were certainly as demanding in their handling characteristics as anything the private pilot in this country is likely to tackle for many years to come.

As for the "real business of being taught how to fly from A to B" a certain amount of initial practice in D/R navigation in suitable weather is surely a necessary preliminary to coping with all the intricacies of the modern air traffic control system, if only to instil that degree of common sense, moderate self-confidence and good airmanship which is so essential if accidents are to be avoided. And the Tiger Moth can provide this initial practice as well as any other aeroplane.

It is comforting to know that you propose the retention of one Tiger Moth per club on account of its "limited" aerobatic capability, for proficiency in aerobatics is, of course, as much a part of "real flying" as the ability to fly safely from A to B. Although the standard Tiger Moth, in common with later trainers, cannot perform all the manœuvres of which their Continental counterparts may be capable, it can certainly provide an extremely valuable introduction to the art. And if the basic aerobatic manœuvres have been well and truly mastered in a Tiger Moth, then neither they, nor the more ambitious antics of which other aeroplanes are capable, will present many problems to the pilot undergoing conversion.

By all means let us have more modern aircraft; certainly we must have radio. But let us not, in our enthusiasm, condemn in terms of childish patronage a very worthy aeroplane which, apart from its impressive record as a Service trainer, was, as you so rightly say, one of the biggest factors in the renaissance of post-war club flying in Britain, and today continues to do a very useful job as an *ab initio* trainer, however quaint the nature of its construction.

Welwyn Garden City, Herts. DAVID B. BROWN.

Groundabout

Not Funny. This item should be in our "Personal Flying" Dept., I suppose. However, hearing that French private flyers have 354 airfields available in their country, I checked the situation here. U.K. score: 190, which rather shook me. I thought we'd be much worse off, though British private flyers will probably say we are.

*

Per Ardua. Speaking of our private flying section, Harry J. Cooper, who covered that aspect so nicely for two years, is finding his new job with Air Ministry Information rather more hazardous. Within a few weeks, he was punished by the Cat., so to speak. He fractured four ribs when his Norwegian Air Force Catalina hit some rough air.

*

I liked the Moscow commentator's proud statement, on their English-speaking radio programme, that their Lunik III was going to photograph the Moon's back side.

*

PRO and CON—6. Final dramatic instalment of our dictionary definitions of P.R.O.-manship:—

PROsaist: One who cannot rise above prose—("What's prose?").

PROpend: To lean forward—("*And* backward, old boy").

PROpination: Ceremony of pledging, or drinking first and then offering the cup to another—("It's the propination that keeps me going").

PROpitious: Disposed to be gracious and merciful—("'Propitious Joe,' they call me").

PROteus: A deity who had the facility of assuming different shapes at will, and so of eluding the grasp of those who would coerce him into a confession of the secrets of the future with which he was presumed to be charged.

*

"Actually, I was in Fighters—what were you in, old boy?" "Wellingtons." "Wellingtons?" "Aye—it were a mucky station."

by Lovens

NOTES AND EVENTS

AVIATION EXPANSION.—Elliott Brothers (London), Ltd., has formed three new divisions to undertake the business at present conducted by its Aviation Division. The three new divisions, which are located at the company's Airport Works, Rochester, are: Aircraft Controls Division (manager, Mr. W. H. Alexander); Aircraft Engine Instruments Division (manager, Mr. F. Haskett); Aviation Service and Repair Division (manager, Mr. F. Shields).

SMITHS PRICE REDUCTIONS.—Smiths Aviation Division announce reductions of 10% to 50% on quantity orders of synchros and small motors.

RADAR FOR OLYMPIC.—Ekco airborne search radar has been ordered for use in two de Havilland Comet 4B airliners on Olympic Airways' European routes.

LOGARITHMIC ATTENUATOR.—Research and Control Instruments, Ltd., will commence marketing the Philips Logarithmic Attenuator in December of this year. This instrument, whilst ensuring constant accuracy throughout the spectrum, provides logarithmic attenuation of pulses before amplification.

B.P. FOR TAA.—A contract to fuel all Trans-Australian Airlines aircraft has been awarded to B.P. Australia Ltd., and to meet the requirements of TAA, equipment has been installed at 40 fuelling centres throughout these areas.

BRISTOL FLIGHT DEVELOPMENT.—Bristol Siddeley Engines Ltd., are concentrating all flight development at Filton. Amongst the additional facilities being built to accommodate the Company's 14 flight development aircraft are a new hangar, an extension to the concrete apron and additional taxi track.

MECHANICAL SEALS.—Flexibox, Ltd., has produced a new comprehensive mechanical seal catalogue in which is described the full range of Flexibox balanced and unbalanced mechanical gland seals for all types of rotary shaft equipment. This catalogue has been primarily designed to provide mechanical seal users with a rapid means of selecting the correct type and size of seal for any given application. Copies are obtainable from the company's P.R. department at Nash Road, Trafford Park, Manchester, 17.

COMPANY CHANGE.—The Dowty Group has announced that the Service Department of British Messier, Ltd., is to be transferred to Dowty Equipment, Ltd., as from November 1, 1959. Manager of the new department will be Mr. W. Spieres, for many years service manager, Dowty Equipment, Ltd.

CHANGE OF TELEPHONE NO.—British Insulated Callender's Cables, Ltd., announce that the telephone number of their Worcester branch office has been altered to Worcester 26966/7.

Company Notices

New Companies

Eurofreight, Ltd. (639,171).—Private co. Reg. Oct. 8. Cap. £100 in £1 shs. Objects: To carry on the business of carriers of goods, mails and passengers by sea, land and air, etc. Subscribers are: Derek Hayes, Dowgate Hill House, E.C.4; Penelope Edwards, Dowgate Hill House, E.C.4. Solrs.: Neish, Howell and Haldane, Dowgate Hill House, E.C.4.

Security Express, Ltd. (639,379).—Private co. Reg. Oct. 12. Cap. £80,000 in £1 shs. Objects: To carry on the business of transport contractors, carriers of goods and passengers by road, rail, water and air. Directors: Sir Percy J. Sillitoe, K.B.E., D.L., 50 St. John's Road, Eastbourne; John A. Shepherd Barron, 22 Ormonde Gate, S.W.3, director of Thomas De La Rue and Co., Ltd.; Anthony W. Sillitoe, 9 Moleshill, Oxshott, Surrey. Sec.: Leslie H. Sawyer. Solrs.: Bristows, Cooke and Carpmael, 1 Copthall Buildings, E.C.2. Reg. office: De La Rue House, 84/6 Regent Street, W.1.

NEW PATENTS

Applications Accepted

825,442.—Heinkecke, H.H. Aircraft. March 19, 1956. (Feb. 8, 1955.)

825,446.—Aerotecnica S.A. Rotary Wing Aircraft. Oct. 31, 1955.

825,332.—Blackburn and General Aircraft, Ltd., Forsyth, D., and Kinroy, R.N. Landing gear of aircraft. Feb. 19, 1958.

825,652.—Soc. Nationale D'Etude et de Construction de Moteurs D'Aviation. Landing devices for aircraft which take off and land vertically. Sept. 18, 1956. (Sept. 19, 1955 and Aug. 1, 1956.)

825,642.—Rolls-Royce, Ltd. Jet noise silencers. May 17, 1957. (May 18, 1956.) Applications open to public inspection on December 16, 1959 and the opposition period will expire on March 16, 1960.

Aviation Calendar

November 6.—Helic. Assn. of G.B. lecture, "The Application of the Jet Flap to Helicopter Rotor Control," by R. Dorand (Giravions Dorand), at the Library, The Royal Aeronautical Society, 4 Hamilton Place, **London,** W.1, at 18.00 hrs.

November 6.—R.Ae.S. Brough Branch Annual Dinner and Dance, at Jackson's Ballroom, **Hull.**

November 9.—Institute of Transport lectures, "Fares Structures": "Air," by J. L. Grumebridge, O.B.E., M.Inst.T.; "Rail," by A. W. Tait, M.Inst.T.; "Road," by A. F. R. Carling, M.Inst.T., at Jarvis Hall, 66 Portland Place, **London,** W.1, at 17.45 hrs.

November 11.—R.Ae.S. Graduates' and Students' Section lecture, "The Flight Testing of Rotorcraft," by Sqn. Ldr. W. R. Gellatly, at the Library, 4 Hamilton Place, **London,** W.1, at 19.30 hrs.

November 11.—R.Ae.S. Brough Branch, 6th Cayley Memorial Lecture, "The Work of the R.A.E. Bedford," by Sir George Gardner, at the Writing Room, Royal Station Hotel, **Hull,** at 19.00 hrs.

November 11.—R.Ae.S. Bristol Branch, film show, at Filton House, Filton, **Bristol,** at 18.00 hrs.

November 11.—R.Ae.S. Chester Branch lecture, "Automobile Aerodynamics," by F. A. Costin, at the Lecture Theatre, Grosvenor Museum, **Chester,** at 19.30 hrs.

November 12.—R.Ae.S. I.o.W. Branch Annual Dinner, at the Ryde Castle Hotel, **Isle of Wight.**

November 13.—R.Ae.S. Agricultural Aviation Group, general discussion on the International Aviation Conference at Cranfield, at the Library, 4 Hamilton Place, **London,** W.1, at 19.00 hrs.

November 16.—R.Ae.S. Henlow Branch lecture, "Flight Development of a Modern Prototype Aircraft," by C. F. Bethwaite, in Building 62, R.A.E. Technical College, **Henlow,** at 19.45 hrs.

November 17.—R.Ae.S. Christchurch, lecture by Maurice Brennan at the King's Arms Hotel, **Christchurch,** at 19.30 hrs.

November 17.—R.Ae.S. lecture, "Magneto-Gasdynamics," by Dr. J. A. Shercliff, at the Library, 4 Hamilton Place, **London,** W.1.

Personal Notices

BIRTHS

Baird.—On October 19, at R.A.F. Hospital, Ely, to Cynthia, wife of D. Baird, R.A.F. Brampton, Hunts—a daughter.

Minihane.—On October 21, at the Croft Baker Maternity Home, Cleethorpes, to Daphne (*née* Noel), wife of Sqn. Ldr. T. R. Minihane, R.A.F.—a son (Nigel Anthony).

MARRIAGE

Bridge-Newman.—On October 24, at St. Joseph's Catholic Church, Rustington, Sussex, Flt. Lt. Ronald William Bridge to Susan Rosemary Newman.

DEATHS

Russell.—On October 21, Wg. Cdr. N. M. S. Russell, after a long illness.

Sawkins.—On October 19, in a flying accident, Flt. Lt. V. A. Sawkins, R.A.F.

Somerset-Leeke.—On October 24, at Roman Way, Bursledon, Wg. Cdr. A. F. Somerset-Leeke, O.B.E., R.A.F. (retd.).

Publications Received

AIRCRAFT ANNUAL. Edited by J. W. R. Taylor. 96 pp.; 7½ in. by 9¾ in. Illustrated. Ian Allan Organisation Co., Ltd. Price 10s. 6d.

BRITISH AIRPORTS. Edited by J. W. R. Taylor. 40 pp.; 7½ in. by 9¾ in. Illustrated. Ian Allan Organisation Co., Ltd. Price 2s. 6d.

BRITISH CIVIL AIRCRAFT, VOL. 1. By A. J. Jackson. 157 pp. Illustrated. Putnam and Co., Ltd. Price 63s.

DESERT SQUADRON. By Victor Houart. 167 pp.; 5½ in. by 8¾ in. Illustrated. Souvenir Press, Ltd. Price 16s.

FAMOUS AIRSHIPS OF THE WORLD. By Captain J. A. Sinclair. 144 pp.; 5 in. by 7½ in. Illustrated. Frederick Muller, Ltd. Price 9s. 6d.

THE WOODEN WONDER. The Story of the de Havilland Mosquito. By Edward Bishop. 168 pp.; 5½ in. by 8 in. Illustrated. Max Parrish and Co., Ltd. Price 16s.

FOOD FOR SURVIVAL, After a Disaster. By R. C. Hutchinson. 90 pp.; 5 in. by 7½ in. Illustrated. The University of Melbourne Press. Price 13s. 6d.

HE FLEW BY MY SIDE. By Erwin Morzfeld. 336 pp.; 5½ in. by 8 in. Macdonald and Co. (Publishers), Ltd. Price 16s.

PRICES OF USED COMMERCIAL AIRCRAFT 1959-1965. By Stephen P. Sobotka, Paul G. Keat, Constance Schnabel, Margaret Wiesenfelder, 111 pp.; 8½ in. by 11 in. Illustrated. Northwestern University, Evanston, Illinois, U.S.A.

THE CROWDED SKY. An Anthology of Flight. Edited by Neville Duke and Edward Lanchbery. 421 pp.; 6¼ in. by 10 in. Cassell and Co., Ltd. Price 30s. *(Reviewed 23/10/59.)*

THE MINISTRY OF TRANSPORT AND CIVIL AVIATION. The New Whitehall Series. By Sir Gilmour Jenkins. 231 pp.; 5½ in. by 8¾ in. George Allen and Unwin, Ltd. Price 21s.

THE NEW FRONTIER, Man's Survival in the Sky. By K. G. Williams, M.R.C.S., Assoc.I.Mech.E. 161 pp.; 5¼ in. by 8¾ in. Illustrated. William Heinemann Medical Books, Ltd. Price 21s.

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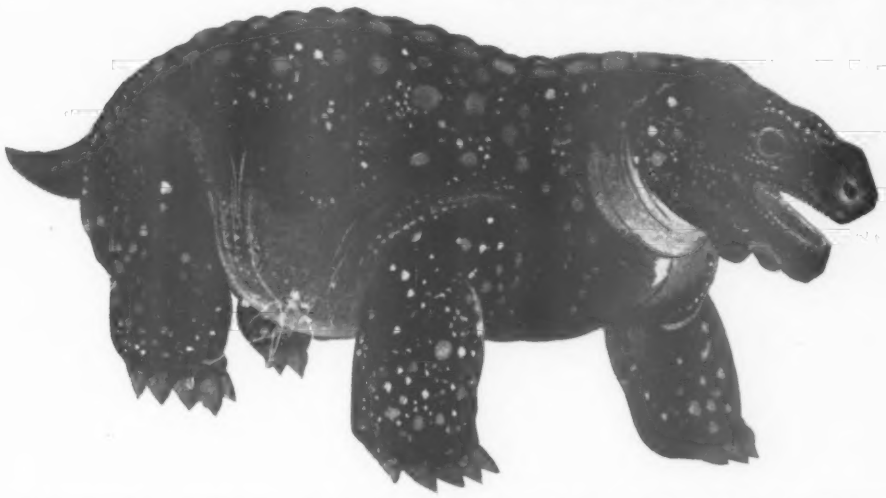

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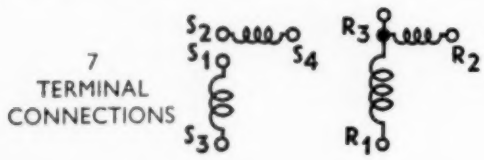
Input voltage at 400 cycles, volts	26	26
Input current, milliamps	20	52
Input power, watts	.15	.34
Transformation Ratio	0.846	0.490
Voltage gradient volts/degree	.38	.22
DC resistance rotor, ohms	200	14
DC resistance stator, ohms	130	76
Phase shift degrees	7°	10°
Residual voltage total, millivolts	58	27
Residual voltage fundamental, millivolts	38	17
Electrical Error, minutes	7 max.	7 max.



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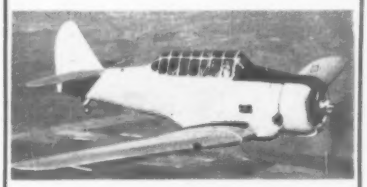

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NOTICES

AIR TRANSPORT ADVISORY COUNCIL

THE AIR TRANSPORT ADVISORY COUNCIL give notice that they have received the undermentioned applications to operate scheduled air services:—

FROM EAGLE AIRWAYS LTD., OF 40 EDGWARE ROAD, LONDON, W.2:—

APPLICATION NO. 1042/5 for permission to include an operational traffic stop at Glasgow on the following Normal Scheduled Services:—London Airport and/or London (Blackbushe)—Lyons (opt. tech.)-Pisa. (Application No. 1042);

Manchester-Lyons (opt. tech.)-Pisa (Application 1429); London Airport and/or London (Blackbushe)-Lyons (opt. tech.)-Rimini of Forli (Application No. 1717);

Manchester-Lyons (opt. tech.)-Rimini (Application No. 2547); and Manchester-Southend (opt. tech.)-Frankfurt-Lyons (opt. tech.)-Rimini (Application No. 3151).

FROM TRADAIR LTD. OF SOUTHEND AIRPORT, ESSEX:—

APPLICATION NO. 2534/1 for an amendment to the terms of approval of the Normal Scheduled Service which they are authorized to operate with Viking aircraft on the route Southend-Maastricht-Nuremburg, at a frequency of two return flights weekly until July, 1966, so as to enable them to operate at an increased frequency of one return flight daily, to use Viscount and Avro 748 aircraft in addition to Viking aircraft and to include opt. traffic stops at Budapest and Bucharest.

FROM B.K.S. AIR TRANSPORT LTD. OF BERK HOUSE, BAKER STREET, LONDON, W.1, for the following Normal Scheduled Services, initially with Dakota and Ambassador aircraft and later, also with Avro 748 aircraft for the carriage of passengers, supplementary freight and mail, at a frequency in accordance with traffic demand on each service, for 10 years from April 1, 1960:—

APPLICATION NO. 3263 on the route Luton-Southend (tech.)-Ostend.

APPLICATION NO. 3264 on the route Luton-Southend (tech.)-Basle.

APPLICATION NO. 3265 on the route Luton-Southend (tech.)-Lille.

APPLICATION NO. 3266 on the route Luton-Southend (tech.)-Rotterdam.

FROM AFRICAN AIR SAFARIS, LTD., OF GATWICK AIRPORT, HORLEY, SURREY, for the following Normal Scheduled Services, with Viking aircraft, for the carriage of passengers only, from March 30, to September 21, 1960:—

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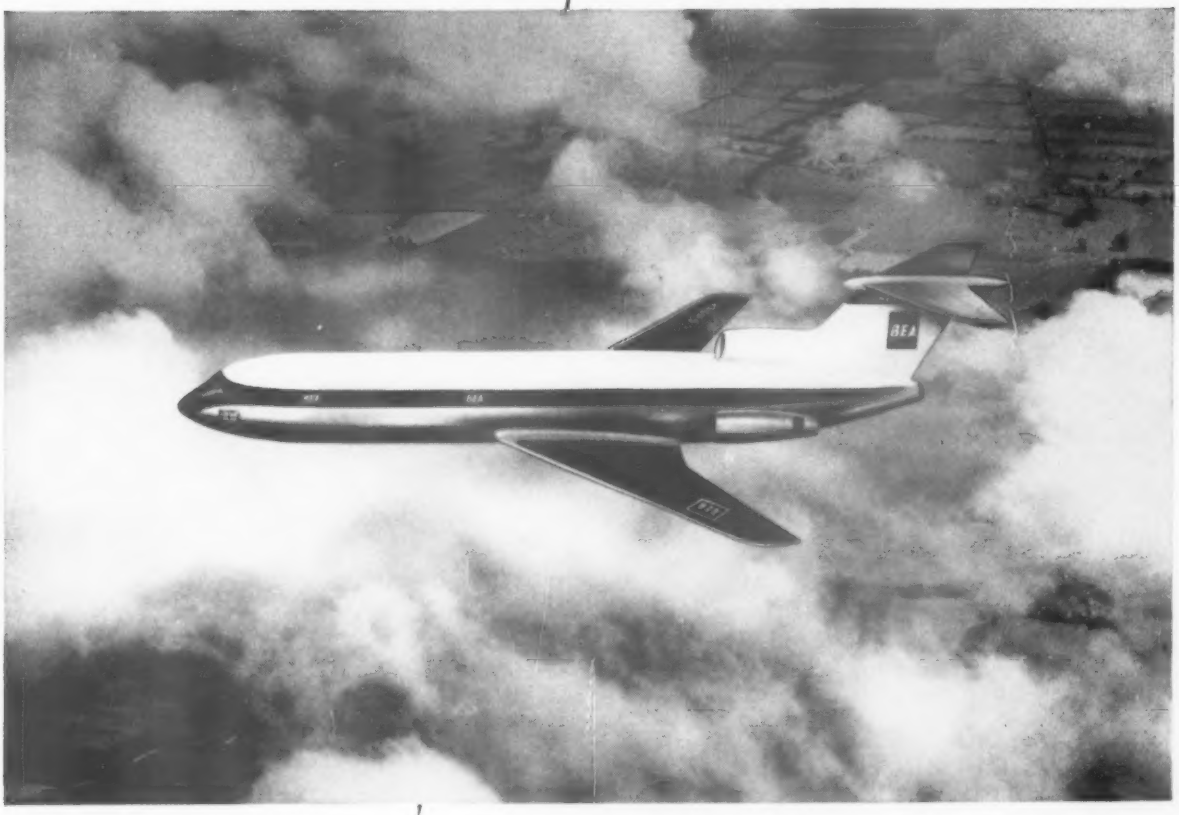

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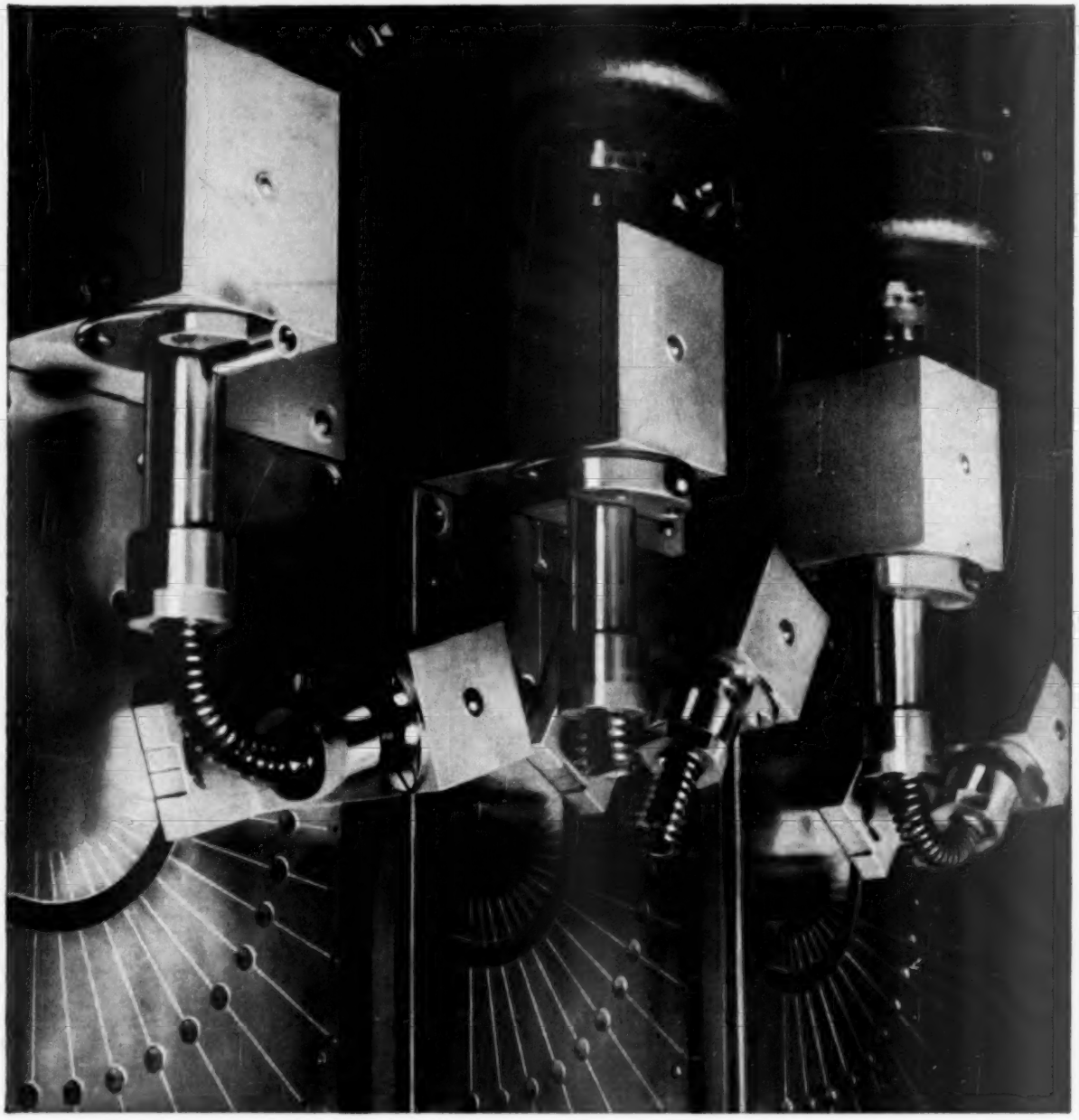

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